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by

Carl K. Eicher and Doyle C. Baker

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RESEARCH ON AGRICULTURAL DEVELOPMENT IN SUB-SAHARAN AFRICA: A CRITICAL SURVEY*

by

Carl K. Eicher** and Doyle C. Baker***

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PREFACE

This survey of literature on the rural economies of sub-Saharan Africa has been prepared at the request of the American Association of Agricultural Economics (AAEA). It will be published in 1983 along with similar reviews on Latin America and Asia in Volume IV of the AAEA's literature surveys.[1/] The survey is being published by Michigan State University as an MSU International Development Paper in advance of publication of the AAEA volume in order to make it quickly available to students, teachers, and researchers in universities and research institutes in Africa.

Our initial mandate was to review the literature on agricultural development by agricultural economists but we have broadened this mandate. First, we review research by economic historians on the precolonial and colonial development experiences. Second, we present a brief overview of the technical literature on farming and livestock systems for the benefit of social scientists. Third, we go beyond the agricultural sector to appraise the literature on the rural nonfarm economy, including small-scale industry, fishing, processing, storage, migration, income distribution, and other topics. Fourth, we present some of the key research findings of political scientists, anthropologists, sociologists, geographers, and technical scientists.

We have had two major goals in preparing this survey. The first is to present a critical review of the major theoretical and policy debates and empirical findings on the development of Africa's rural economies. The second is to identify the major research gaps and research directions for the 1980s and 1990s. During the 1970s, Africa began to receive the attention of scholars and donor agencies which was noticeably lacking in the 1950s and 1960s. Because of lagging food production and widespread poverty, Africa is likely to receive even more attention in the coming decades than it has in the past relative to Asia and Latin America and it is important that research resources be wisely and effectively used.

This project began several years ago when the authors were a Resident Scholar and a Research Associate, respectively, at the Woodrow Wilson International Center for Scholars, in Washington, D.C. We gratefully acknowledge the support of the Wilson Center, its staff, and the opportunity we had to draw on the resources of the Library of Congress. The bulk of the research and preparation of the survey has been carried out in the Department of Agricultural Economics at Michigan State University. The project would never have been realized without the support of Larry Connor and Lester

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[1/] Lee Martin, ed. A Survey of Agricultural Economics Literature: Vol. IV. Agriculture in Economic Development. Minneapolis, University of Minnesota Press, 1983.

Manderscheid. Laura Wilson helped with the tedious task of checking and rechecking our bibliographical references. Joe Lauer, Director, MSU Sahel Bibliographic Center, provided valuable advice on citations for many difficult references. Lucy Wells and Jeanette Barbour were tireless in typing and retyping a number of drafts and redrafts.

We also would like to acknowledge the invaluable help from the following reviewers: Vincent Barrett, Sara Berry, Derek Byerlee, Enyinna Chuta, Eric Clayton, John Cohen, Mike Collinson, Eric Crawford, Bob Deans, Christopher Delgado, W. Doppler, John Erikson, B. Falusi, Don Ferguson, Pascal Fotzo, Russell Freed, Donald Heisel, Lane Holdcroft, Francis Idachaba, R.W. Palmer-Jones, M.C. Latham, Uma Lele, Carl Liedholm, A.R.C. Low, R.E. McDowell, K. Meyn, Isaac Minde, M. Miracle, Wilford W. Morris, W. Mwangi, David Norman, O. Ogunfowora, Kenneth Robinson, Stephen Sanford, Tjaart Schillhorn, Kenneth Shapiro, John Staatz, Martin Upton, William Whelan, and David Wilcock.

We would like to especially express our gratitude to the Editor of the Survey Volumes, Lee Martin of the University of Minnesota. Lee Martin's insightful comments have helped us revise the manuscript and bring it up to his high standards. The support of our wives, Shirley Eicher and Kathy Baker, has been invaluable. Finally, we would like to thank the innumerable researchers who are responsible for the research on which this survey is based. They have contributed to our understanding of African rural economies. We, of course, take full responsibility for the interpretations and views presented in these pages.

Carl K. Eicher and Doyle C. Baker

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ACRONYMS USED IN TEXT AND REFERENCES

ACE = American Council on Education, Washington

ADC = Agricultural Development Council, New York

AID = U.S. Agency for International Development, Washington

AMIRA = Groupe de Recherche pour l'Amelioration des Methodes d'Investigation en Milieu Rural Africain (Research Group on the Improvement of Survey Methods in Rural Africa), Paris

BRALUP = Bureau of Resource Assessment and Land Use Planning, University of Dar es Salaam

CARDAN = Centre d'Analyse et de Recherche Documentaires pour l'Afrique Noire (Documentary Analysis and Research Center for Africa), Paris

CEEMAT = Centre d'Etudes et d'Experimentation du Machinisme Agricole Tropicale (Center for Studies and Experimentation on Tropical Agricultural Machinery), Antony, France

CGIAR = Consultative Group on International Agricultural Research, Washington

CILSS = Comite Permanent Inter-Etats de Lutte Contre la Secheresse au Sahel (Permanent Inter-State Committee of Drought Control in the Sahel), Ouagadougou

CIMMYT = Centro Internacional de Mejoramiento de Maiz y Trigo (International Maize and Wheat Improvement Center), Mexico D.F.

CNRA = Centre National de Recherches Agronomiques (National Center for Agronomic Research), Bambey, Senegal

CODESRIA = Council for the Development of Economic and Social Research in Africa, Dakar

CRED = Center for Research on Economic Development, University of Michigan, Ann Arbor

ECA = United Nations, Economic Commission for Africa, Addis Ababa

ECOWAS = Economic Community of West African States

FAO = Food and Agriculture Organization of the United Nations, Rome

IADS = International Agricultural Development Service, Washington

IAR = Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria

IBRD = International Bank for Reconstruction and Development (World Bank)

ICRISAT = International Crops Research Institute for the Semi-Arid Tropics, Hyderabad

IDEP = Institut Africain de Developpement Economique et de Planification (African Institute for Economic Development and Planning), Dakar

IDRC = International Development Research Centre, Ottawa

IDS = Institute for Development Studies, University of Nairobi, Nairobi

IEMVT = Institut d'Elevage et de Medecin Veterinaire de Pays Tropicaux (Institute of Livestock and Veterinary Medicine for Tropical Countries), Maisons-Alforet, France

IER =	Institut d'Economie Rurale (Institute of Rural Economy), Bamako
IFAD =	International Fund for Agricultural Development, Rome
IFDC =	International Fertilizer Development Center, Muscle Shoals, Alabama
IFPRI =	International Food Policy Research Institute, Washington
IITA =	International Institute of Tropical Agriculture, Ibadan
ILO =	International Labor Office, Geneva
INRAN =	Institut National de Recherche Agronomique (National Institute of Agronomic Research), Niamey
INSEE =	Institut National de la Statistique et des Etudes Economiques (National Institute of Statistics and Economic Studies), Paris
IRAT =	Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres (Institute of Agronomic Research on Tropical Crops), Paris
ISRA =	Institut Senegalais de Recherches Agricoles (Senegalese Institute of Agricultural Research), Dakar
ISSER =	Institute of Statistical, Social, and Economic Research, University of Ghana, Legon
MIT =	Massachusetts Institute of Technology, Cambridge, Massachusetts
NISER =	Nigerian Institute of Social and Economic Research, Ibadan
OACV =	Operation Arachide et Cultures Vivrieres (Groundnuts and Food Crops Operation), Mali
OAU =	Organization of African Unity, Addis Ababa
ODC =	Overseas Development Council, Washington
ODI =	Overseas Development Institute, London
OECD =	Organisation for Economic Cooperation and Development, Paris
ORSTOM =	Office de la Recherche Scientifique et Technique Outre-Mer (Overseas Scientific and Technical Research Office), Paris
SAREC =	Swedish Agency for Research Cooperation With Developing Countries
SEDES =	Societe d'Etudes pour le Developpement Economique et Social (Economic and Social Development Studies Corporation), Paris
UNDP =	United Nations Development Program, New York
USDA =	United States Department of Agriculture, Washington
WARDA =	West African Rice Development Association, Monrovia
WHO =	World Health Organization, Geneva

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I. INTRODUCTION

Sub-Saharan Africa is a vast subcontinent comprised of 41 countries[1/] with heterogeneous endowments of resources, colonial histories, and levels and opportunities for development (Figure 1). The population of Africa is presently about 350 million but Nigeria with 80 million people has one-fourth of the population and produces 46 percent of the gross national product of the region. Population densities in Africa are extremely low relative to Asia. The Sudan, for example, is two-thirds the size of India but it has only 18 million people as compared with 670 million in India. The Republic of Zaire (formerly the Belgian Congo) is five times the size of France but only 5 percent of its arable land is estimated to be under cultivation.

Although the density of population as a whole is low relative to Asia, the distribution is uneven and there are areas that are near maximum capacity given present agricultural technology and knowledge of how to deal with soil erosion and environmental problems. Moreover, according to recent estimates by the United Nations, sub-Saharan Africa is the only region in the world where the rate of natural growth of population increased over the 1960-80 period (U.N., 1981). The population growth rate increased from 2.5 percent in the 1960s to an estimated rate of 2.7 to 2.9 percent in the 1970s[2/] and is projected to be 3.0 percent per year over the 1980-85 period (World Bank, 1980).

In Africa, 60 to 90 percent of the people are in the agricultural sector, in contrast to 30 to 50 percent of the population in most Latin American nations. Agricultural and mineral exports dominate most African economies as they do in many Latin American

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[1/] The definition of sub-Saharan Africa normally includes 40-46 countries depending on the number of off-shore islands--e.g., Seychelles, Mauritius--one wishes to include. We have excluded the Republic of South Africa and some of the off-shore islands and arrived at an arbitrary list of 41 countries to include in this survey (see Table 1, page 4).

[2/] The World Bank (1981b) estimate is 2.7 percent and the UN (1980) estimate is 2.9 percent. The population picture has a bright side, however. The life expectancy at birth has increased from an estimated 38 years in 1950 to almost 50 years in 1980--and the crude death rate has fallen from an estimated 27 per 1,000 in 1950 to 18 per 1,000 per year in 1980.

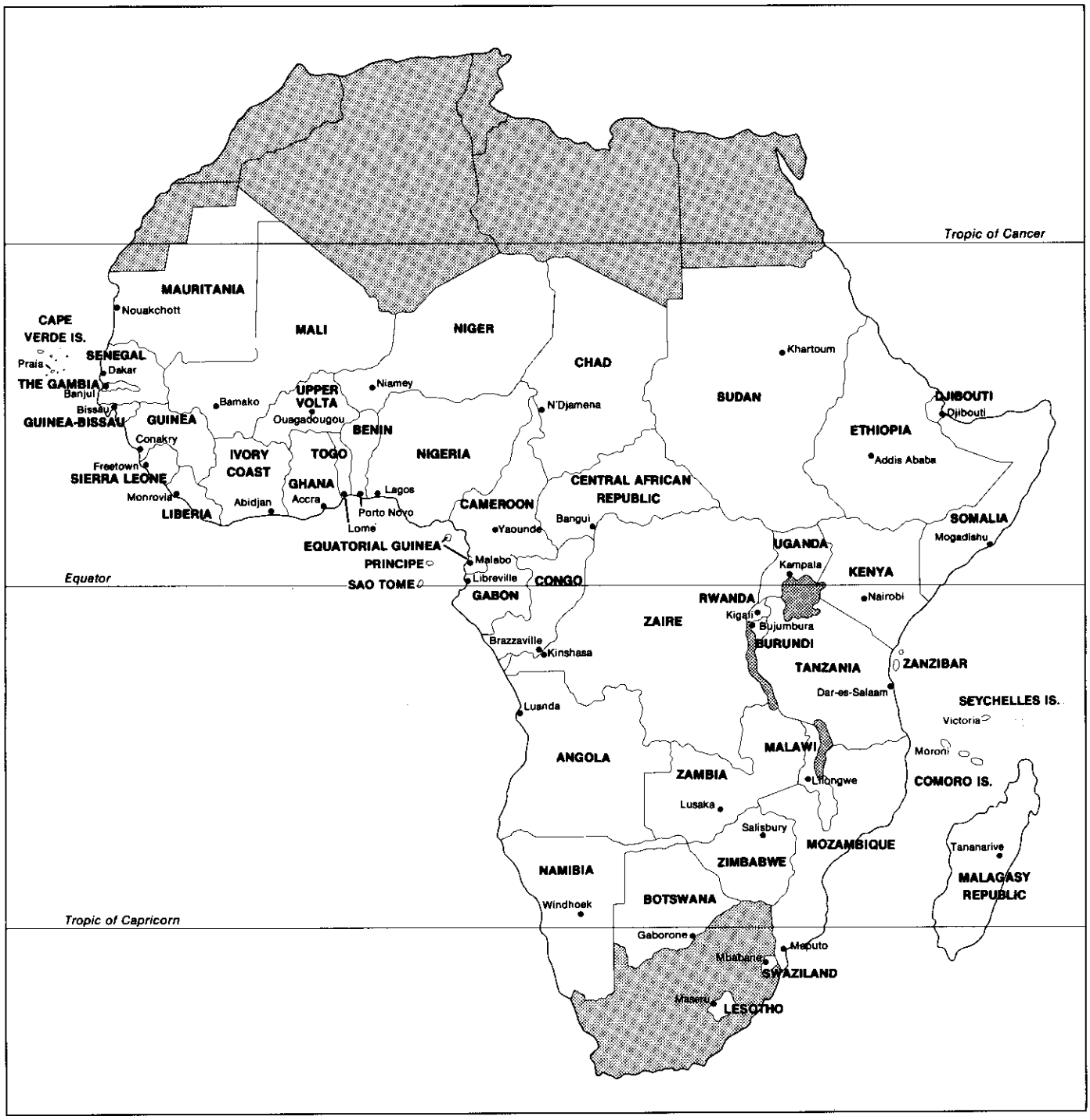

Figure 1. Countries in Sub-Saharan Africa Included in Literature Review

countries. But unlike much of Latin America, the size of the industrial sector is extremely modest in most African countries and agriculture is claimed to be the foundation of nearly all national development programs. Although the rate of growth of African cities is currently the highest in the world, sub-Saharan Africa continues to be the least urbanized region. Overall, the population was about 70 percent rural in 1980 compared with about 80 percent in 1960, but the percentage varies from 54 percent rural in Ghana to around 90 percent in Tanzania and Upper Volta. It is clear that for the next 25 to 50 years the majority of the population of most countries will continue to live in rural areas.

Sub-Saharan Africa is the poorest part of the world's economy. The World Bank's World Development Report, 1981 shows, for example, that 22 of the 36 of the low-income countries in the world are sub-Saharan African countries.[1/] Moreover, the rate of economic growth of sub-Saharan Africa has been bleak relative to the other regions of the world over the past ten years. For example, the average rate of growth of GNP per capita for the 22 low-income sub-Saharan African countries was -0.4 percent compared to 1.1 percent for low-income countries in Asia for 1970-80 (World Bank, 1981a, p. 3). Table 1 reveals that 7 countries had a negative average annual growth rate of GNP per capita during the 1970s.

Turning to the performance of the agricultural sector, of the 22 countries in the World Bank's category of low-income countries in sub-Saharan Africa, 5 experienced negative rates of growth of agricultural output over the 1970-79 period (see Table 1). Three middle-income countries--Angola, Ghana, and Nigeria--also experienced negative agricultural growth during the 1970s. In only 11 of 31 countries for which data are available did the average annual growth rate of agriculture exceed the growth rate of population.

One of the most disturbing trends over the last 20 years has been declining per capita production of food crops (FAO, 1978). The USDA (1981) points out that sub-Saharan Africa is the only region of the world where per capita food production declined over the past two decades. As a result, the average per capita calorie intake was below minimum nutritional levels in most countries during this period and many countries which were formerly self-sufficient in food have increased the ratio of food imports to total food consumption. The declining per capita food production being experienced in most countries has led to what many observers are now calling an "agrarian crisis" or "Africa's food crisis" (see Eicher, 1982).

[1/] The World Development Report, 1981 defines low-income countries as countries with per capita incomes of $370 or less (in 1979 dollars).

Table 1. Social and Economic Indicators for Sub-Saharan Africa

Country	Population Size 1980 (Millions) [a]	Average Annual Growth Rate of Population (%) 1970-1979 [b]	GNP Per Capita 1979 [b]	Average Annual Growth Rate of GNP Per Capita (Real) (%) 1970-1979 [b]	Average Annual Growth Rate (%) of Agriculture 1970-1979 b	Average Index of Food Production Per Capita (1969-71=100) 1977-1979 b	Life Expectancy at Birth (Years) 1979 b	Adult Literacy Rate (%) 1976 b
Angola	7.1	2.3	440	-2.1	-10.2	85	42	..
Benin	3.5	2.9	250	0.6	..	97	47	11[e]
Botswana	.8	2.0[c]	660[d]	13.2[c]	..	..	..	..
Burundi	4.2	2.0	180	2.1	1.8	105	42	25
Cameroon	8.4	2.2	560	2.5	3.5	110	47	..
Cape Verde	.3	1.9[c]	260[d]	..	..	..	..	..
Central African Republic	2.3	2.2	290	0.7	2.4	102	44	..
Chad	4.5	2.0	110	-1.4	0.7	91	41	15
Congo	1.5	2.5	630	0.9	0.1	81	47	50[e]
Equatorial Guinea	.4	2.2[c]	..	..	..	..	..	..
Ethiopia	31.5	2.1	130	1.3	0.4	84	40	15
Gabon	.6	1.1[c]	3370[d]	8.6[c]	..	..	..	..
Gambia	.6	3.1[c]	180[d]	2.9[c]	..	..	..	..
Ghana	11.7	3.0	400	-0.8	-0.2	82	49	30[e]
Guinea	5.0	2.9	280	0.3	3.0[c]	86	44	20
Guinea Bissau	.6	1.6[c]	160[d]	2.9[c]	..	..	..	..
Ivory Coast	8.0	5.5	1040	2.4	3.4	102	47	20
Kenya	16.5	3.4	380	2.7	5.4	92	55	45
Lesotho	1.3	2.3	340	6.0	1.8	100	51	52
Liberia	2.0	3.3	500	1.6	5.0	101	54	30
Madagascar	8.7	2.5	290	-0.4	0.1	94	47	50
Malawi	6.2	2.8	200	2.9	4.1	100	47	25
Mali	6.9	2.6	140	1.1	4.2	88	43	10
Mauritania	1.6	2.7	320	1.9	-1.4	75	43	17
Mozambique	10.5	2.5	250	0.1	-1.8	75	47	..
Namibia	1.0	2.8[c]	1160[d]	.6[c]	..	..	..	..
Niger	5.3	2.8	270	-1.3	-1.5	89	43	8
Nigeria	77.1	2.5	670	3.7	-0.3	87	49	..
Rwanda	4.8	2.8	200	1.5	..	107	47	23[e]
Senegal	5.7	2.6	430	-0.2	3.6	88	43	10
Sierra Leone	3.5	2.5	250	0.4	2.3	87	47	15[e]
Somalia	4.6	2.3	130[d]	3.1[c]	2.7	85	44	60
Sudan	18.4	2.6	370	0.6	2.7	105	47	20
Swaziland	.6	2.5[c]	580[d]	4.8[c]	..	..	..	..
Tanzania	17.9	3.4	260	2.3	4.9	94	52	66
Togo	2.6	2.4	350	1.1	0.3	81	47	18
Uganda	13.2	3.0	290	-0.2	0.8	90	54	..
Upper Volta	6.9	1.6	180	0.3	-3.3	93	43	5[e]
Zaire	28.3	2.7	260	0.7	1.2	90	47	15
Zambia	5.8	3.0	500	0.8	2.3	99	49	39
Zimbabwe	7.4	3.3	470	0.8	-0.5	100	55	..

Source: [a]United Nations, World Population Prospects, 29 April 1981.

[b]World Bank, World Development Report, 1981.

[c]Figures are for 1970-78, World Bank, World Development Report, 1980.

[d]Figures are for 1978, World Bank, World Development Report, 1980.

[e]Figures are for 1975, World Bank, World Development Report, 1980.

Key .. Not available.

The prospects for economic development in sub-Saharan Africa in the 1980s are not encouraging. Nearly all African nations are overwhelmingly dependent upon agriculture for the bulk of their national income, employment, and foreign exchange but only a few countries such as Malawi, Zimbabwe, and the Ivory Coast have harnessed their agriculture as an "engine of growth" of the overall economy. The few countries where economic progress is reasonably optimistic are oil exporting, Nigeria and Gabon. Only a few countries are not facing a food crisis. But this bleak assessment should not overlook the major achievements in many countries during the past three decades. A few countries--Kenya, Malawi, and the Ivory Coast--have achieved respectable rates of economic growth over the past 10-20 years. The achievements in education have been dramatic in a few countries such as Tanzania and Somalia. For example, in Tanzania, literacy rates increased from 10 percent in 1960 to 66 percent in 1975. But adult literacy is below 25 percent in most countries in sub-Saharan Africa.[1/]

Scope of Review

This survey focuses on the rural economy which is broadly defined to include the agricultural sector plus rural nonfarm activities such as small-scale industry, trade, processing, and fishing. In addition, we review research on migration, employment, and income distribution in order to understand linkages between the agricultural and nonagricultural sectors. We have adopted a broad rural economy perspective for our review rather than focusing on the agricultural sector because research has shown that rural households in sub-Saharan Africa typically allocate from 25 to 40 percent of their labor to nonfarm activities.

We begin by identifying standard references on African agricultural development and presenting a descriptive overview of agricultural systems in sub-Saharan Africa. In Part II, we examine research on food and agricultural policy in historical perspective starting with the precolonial period (1800-1880s) and moving to the colonial period which covered the 1880s-1960 period. We also discuss the key theoretical perspectives on agricultural development which have had an important influence on policy makers and scholars working in Africa. We then move in Part III to policy debates during the postindependence period of the sixties and seventies. In the 1960s, most African governments stressed industrialization and large-scale farming, including what a World

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[1/] Compared with other regions of the world, the cost of education per pupil as a percentage of GNP per person is the highest of any region of the world. For example, this ratio in West Africa is more than twice as high for primary education as compared with Asia and five times as high for secondary education as for Asia (World Bank, 1980). The high cost of education per student is largely a function of teachers' salaries which typically account for 75 percent of educational cost (Hanson, 1980).

Bank mission to Tanzania called the "transformation approach" to modernizing African agriculture. Despite numerous experiments with large-scale farming and ranching schemes during the colonial and postindependence periods, the bulk of the land and labor in sub-Saharan Africa is still devoted to small-scale farming and pastoral systems of livestock production.

In the late 1960s and early 1970s, many policy makers, planners, and foreign donors shifted their attention to small-scale farming and small-scale livestock projects. In light of this shift in policy, we devote substantial attention in Parts IV to VI to micro research on smallholder crop and livestock production. In Part VII, we shift to research on food and agricultural distribution systems, reviewing research on topics such as international trade, marketing, processing, and storage; and research on credit, cooperatives, consumption, and nutrition. Finally, in Part VIII, we move to research on equity and employment issues such as income distribution and inequality, population, migration, women in development, small-scale industry, and fishing.

Several caveats are in order. First, throughout this review, we shall emphasize research completed since 1970. The literature of the 1960s has already been covered in a number of surveys, including McLoughlin (1967) for East Africa and Eicher (1970) for West Africa. Second, we have limited our references as much as possible to journal articles and books and have deemphasized unpublished reports and theses.

Third, we have found it impossible to provide uniform coverage of the literature by topic and for each of the 41 countries. We are struck by the unevenness of the research coverage and the number of publications by country. This unevenness is dramatized by comparing the number of publications in the references for Niger, Nigeria, Botswana, and Chad. For example, Sims and Kagan (1976) report that there were 4 American and Canadian Doctoral dissertations and Master's theses on Niger and 714 for Nigeria over the 1886-1974 period. Shirley Eicher (1981) cites 1,280 publications in her bibliography on rural development in Botswana from independence in 1966 to 1981. If some countries such as Chad, Niger, and Rwanda seem to be undercited in our survey, it is partially because of language barriers and political instability, and partially because the research industry like the fashion industry is trendy. For example, almost every Western researcher tried to touch down in Tanzania sometime during the last 15 years to gain some first-hand impressions of the Ujamaa experiment and the villagization program. The fascination with Tanzania has produced a vast amount of literature. For example, Kocher and Fleisher (1979) cite 761 publications in their bibliography on rural development in Tanzania from independence in 1960 through 1979. For this reason, one can say that Tanzania has been vastly overstudied relative to countries such as Somalia, the Gambia, and Rwanda.

Another caveat about the danger of generalization about African agriculture comes from one of our reviewers--Dr. Francis Idachaba--of the University of Ibadan. Dr. Idachaba observed that he could find an exception to almost every generalization in the first draft of this survey. To quote:

> Nigeria is an important exception to the recurring treatment of the prices of cotton and groundnuts relative to the prices of food grains (guinea corn and millet). It has been the Nigerian experience in recent years for farmers to shift from cotton and groundnut production to food grain production in response to higher relative prices of food grains. Nigeria is also an important exception to the issue of rural underemployment, unemployment, and rural employment generation. Labour shortage at economic rural wages is the most important resource constraint facing Nigerian farmers today.1/

Dr. Idachaba's points are well taken. One could find exceptions to every generalization about research findings or research gaps when one includes 41 countries in a survey. We agree that there is no such thing as a typical African economy and that it is dangerous to advance generalizations for a sub-continent four times larger than the United States.

A final caveat is in order when the authors are from the same sub-discipline--agricultural economics. Since agricultural development is a technical, social, and political process, the literature of any sub-discipline such as agricultural economics will fall short of capturing the complexity of the development process. Albert Hirschman sums up this problem in his analysis of the rise and decline of development economics over the past 25 years as follows:

> Development economics started out as the spearhead of an effort that was to bring all-around emancipation from backwardness . . . By now it has become quite clear that this cannot be done by economics alone. It is for this reason that the decline of development economics cannot be fully reversed: our sub-discipline had achieved its considerable luster and excitement through the implicit idea that it could slay the dragon of backwardness virtually by itself or, at least that its contribution to this task was central. We now know that this is not so; a consoling thought is that we may have gained in maturity what we have lost in excitement. (1981, p. 23)

1/ Personal communication, February 27, 1981.

Standard References

Until the 1960s, social science research on Africa was dominated by anthropologists, historians, and geographers. Anthropologists--mostly Europeans-were noted for their ethnographic studies which were largely financed by colonial offices in the 1930s, 1940s, and 1950s. A handful of agricultural economists and economists started to pursue research in sub-Saharan Africa beginning in the 1950s and the number greatly expanded in the 1960s. But the technical and social science knowledge base for agriculture continues to be sparse and uneven. Except for a few countries such as Nigeria and Kenya, agricultural research is fragmentary and the scientific knowledge base--especially for food crops--is 10 to 20 years behind most Latin American and Asian countries.

Despite the generally weak data base, a number of studies over the last 20 years have been extremely useful to policy makers, scholars, and donor agencies. Foremost is the two-volume study coordinated by John de Wilde for the World Bank. De Wilde et al. (1967) drew on information from thirteen agricultural projects; five in Kenya, two each in Uganda and Mali, and one each in Tanzania, Upper Volta, Chad, and the Ivory Coast. The first volume, the synthesis, contains information about the distinguishing features of agriculture, response of farmers to incentives, labor allocation, mechanization, land tenure, extension, credit, and marketing institutions. Volume two includes case studies. A classic of the 1960s that unfortunately has received little attention is Jurion and Henry's (1969) Can Primitive Farming Be Modernized? This book summarized the extensive research of the Belgian scientists at the INEAC research station which was established in northern Zaire (formerly Belgian Congo) in the 1930s.

Two important books based on many years of micro-economic research experience in Africa are Michael Collinson's (1972) Farm Management in Peasant Agriculture and Martin Upton's (1973) Farm Management in Africa. Collinson draws on many years of farm level research experience in Tanzania to show how practical farm management studies can contribute to the needs of extension workers and local planners. Upton's text stresses the application of production economics to the study of farming systems.

Standard references of the mid-1970s include John Cleave's (1974) African Farmers, the authoritative volume on labor use in African agriculture, and Uma Lele's (1975) The Design of Rural Development which summarizes problems encountered in 17 major rural development projects in Eastern and Western Africa. Valuable sources on the diverse cropping systems and technical problems are Benneh (1972); Leakey and Wills (1977); and Morgan (1978). Particular attention should be given to the classic by the late Hans Ruthenberg, Farming Systems in the Tropics (1980).

Agricultural development strategies and policy issues are covered in edited volumes by Bunting (1970); McLoughlin (1970); Amann (1973); and Ofori (1973). Recent books with a policy orientation include a comparative study by Anthony et al. (1979) Agricultural Change in Tropical Africa; a collection of papers edited by Bates and Lofchie (1980) entitled Agricultural Development in Africa; Rice in West Africa by Pearson, Stryker, Humphreys et al. (1981); and a collection of 13 case studies edited by Heyer, Roberts, and Williams, Rural Development in Tropical Africa (1981).

There are four basic reports that are indispensable for examining the crisis in food and agriculture in sub-Saharan Africa. The first is FAO's Regional Food Plan (FAO, 1978) which outlines the background to Africa's food crisis and steps to meet it. The Food Plan was endorsed by the Organization for African Unity (OAU) in Arusha in 1978 and in Monrovia in 1979. The second is the Lagos Plan of Action (OAU, 1980) which was endorsed by the African heads of state when they met in Lagos in April 1980. The Lagos Plan calls for massive increases in foreign assistance and measures to increase food production. The third basic document is the USDA's Food Problems and Prospects in Sub-Saharan Africa (1981). The USDA report discusses trends in the demand and supply of food over the 1960-81 period. The fourth basic reading is the World Bank's Accelerated Development in Sub-Saharan Africa: An Agenda for Action (1981).

Overview of Agricultural Systems

There are numerous methods of classifying agricultural systems in sub-Saharan Africa. Ruthenberg (1980) identifies six approaches, including (1) type of rotation, (2) intensity of cultivation, (3) water supply, (4) cropping pattern and animal activities, (5) implements used for cultivation, and (6) the degree of commercialization. Benneh (1972) argues that since the "pivot of every system of agriculture is the technique used to restore soil fertility," the method of fertility restoration should be the basis for classifying agricultural systems. Morgan (1978) classifies systems on the basis of purpose (commercial versus subsistence), type of management, and enterprise class (single staple dominant, two or more staple dominant, mixed crops and livestock, and livestock). In this review, we shall distinguish farming systems and livestock systems since there is little mixed farming in Africa. While many farmers raise poultry and small ruminants, the large ruminant livestock economy is based on herding as a distinct activity from farming.

Farming Systems

We identify farming systems on the basis of three characteristics: ecological zone, intensity of rotation, and major crops.[1/]

[1/] The division into small and large farms is frequently used in the literature and will be used in this survey.

Ecological Zones

Knowledge of soil and water resources in various ecological regions is crucial for understanding farming and livestock systems. Ecological zones in West Africa can be divided into three to seven classifications. A three-tier classification which is commonly sub-divided into several sub-zones includes the Sahelian, Sudanian, and Guinean zones.[1/]

The Sahelian zone, also referred to as the sub-desert wooded savanna, has less than 500 mm of rainfall annually and the rainfall tends to be irregular in amount and distribution. In the northern part of the Sahelian zone, the rainy period is frequently less than 55 days, the minimum period needed for settled rainfed farming. While the northern Sahel is unsuitable for farming, herders migrate throughout the zone searching for pockets of grass which grow in riverbeds after the sporatic rains. Throughout the Sahelian zone, the open water evaporation rate generally exceeds 2,000 mm per year, in part attributable to desiccating winds such as the harmattan which originate in the Sahara in the dry season and move southward.

The Sudanian zone (or arid wooded savanna) is characterized by open grassland and an annual average of 500 to 800 mm of rain. This zone has favorable climate and soils for farming, particularly the southern part of the zone which is intensively farmed. Areas with rainfall exceeding 650 mm are considered a transition zone from the arid to humid wooded savannas and are often referred to as the northern Guinean zone.

The Guinean zone proper has rainfall exceeding 1,000 mm per annum with the rainfall distributed over a 120- to 190-day period. This zone is the most extensive in West Africa and it has high agricultural potential. The Guinean zone includes the sub-arid wooded savanna, sub-humid savanna, and the humid forest zone. The southern part of the Guinean zone, commonly referred to as the sub-humid tropics or forest zone, is characterized by heavy rainfall during most of the year and reliance on swamp rice and root and tuber crops (Leakey and Wills, 1977). Parts of the Guinean zone are further classified as derived savanna. The derived savanna refers to former forest land which has been irreversibly transformed into a semi-wooded landscape as a result of farming activities.

The above classification of ecological zones applies to a wide band across West Africa south of the Sahara. There is not a comparable pattern of ecological zones in Eastern and Central Africa where the zones are greatly influenced by variation in

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[1/] The three-tier classification scheme has been refined by several researchers, most notably by Phillips (1959) who uses a seven-zone classification: Desert-Southern Saharan Fringe, Sub-Desert Wooded Savanna, Arid Wooded Savanna, Sub-Arid Wooded Savanna, Mild Sub-Arid Wooded Savanna, Sub-Humid Wooded Savanna, and the Derived Savanna. The northern Guinea is the most intensively farmed zone of West Africa because rainfall is more reliable than more northern zones and the zone remains free of tsetse.

altitude. The semi-arid belt of the Sahelian and Sudanian zones in West Africa does continue into southern Sudan and south through Kenya and Tanzania, but the distribution of rain and its seasonal character changes (Ahn, 1977). In many of the highlands of East Africa and Rwanda and Burundi, soils are of volcanic origin and rainfall is generally sufficient to grow a wide range of crops. In contrast to West Africa where there is one rainy season from May to September, in the East African savanna rainfall has a bi-modal distribution which is variable in amount and length.

Intensity of Cultivation

The intensity of cultivation can be used to distinguish among shifting cultivation, fallow, and permanent cultivation systems. A simple criterion for classifying the intensity of a system is the relationship between crop cultivation and fallowing. Following Ruthenberg (1980), the index of land use intensity (R) is defined as the years of cultivation multiplied by 100 and divided by the sum of the number of years in cultivation plus the number of years in fallow. A value of 0 is given for land in permanent fallow and a value of 100 for continuous cultivation.

Shifting cultivation[1/] is a system of growing crops for a few years on selected fields and then allowing the land to rest and regenerate for a lengthy period--often exceeding 20 years (Ruthenberg, 1980). Shifting cultivation is predominantly practiced in humid and semi-humid climates such as in the forests of Central Africa and in the lowlands of West Africa. Migration is an integral feature of systems of shifting cultivation and nomadic pastoralism as households move periodically to more fertile land.

Fallow systems are generally defined as those in which one-third to two-thirds of the land is cultivated each year (the land use intensity (R) ranges between 33 and 66). Landholdings are usually clearly defined in fallow systems and the rural households have permanent housing or they move occasionally over short distances. The economic importance of fallow farming systems is far greater than that of shifting cultivation systems. A modified form of fallow cultivation systems found throughout sub-Saharan Africa is the ley system. Ruthenberg defines a ley system as one in which several years of arable cropping are followed by several years of grass and legumes for livestock. Regulated ley systems, which may include both pasture management and planting of grass leys, are found on large farms in Zambia, Zimbabwe, the Kenyan highlands, and in some settlement schemes in other countries.

[1/] "Shifting cultivation" is a particular type of swidden agriculture in which homesteads are frequently moved so as to remain close to fields which are only cultivated for a few years. Standard references on shifting cultivation are De Schlippe (1956), Nye and Greenland (1960), and Allan (1965).

In systems of permanent cultivation, arable crops are only rarely interspersed with fallow or leys. A land use system is considered permanent cultivation when the land use intensity (R) exceeds 70. The major problem of permanent cultivation systems is maintaining soil fertility. Efforts to maintain yields in the face of higher land use intensity have forced farmers to modify their land use practices. One of the most widely noted responses to a reduction in soil fertility is to farm fields closer to the compound more intensively, using household wastes and animal manure to enrich the soil.

Major Crops

The heterogeneity of ecological conditions in sub-Saharan Africa is reflected in the diversity of cropping patterns. In general, one or two staple food crops dominate cropping systems in each ecological zone and can account for as much as 70 to 80 percent of the area cultivated. After giving priority to planting their dominant staples, African farmers rely on a strategy of diversified production, incorporating food crops, cash crops, and non-farm activities. While ecological conditions, principally the amount and distribution of rainfall, determine the dominant crop or crops in any region, there is variability in the combinations of secondary crops grown in any village, by given farmers.

Cereal grains are the most important crops grown in the semi-arid regions of sub-Saharan Africa, both in terms of acreage and calories. The major cereal grains are sorghum, millet, maize, rice, wheat, and teff (in Ethiopia). In most parts of Africa, grains are intercropped with secondary crops such as cowpeas, beans, and vegetables. Intercropping (mixed cropping) entails growing two or more crops at the same time on the same field.

Sorghum and the various millets are the most widely grown crops. Sorghum is concentrated in a belt south of the Sahara where rainfall ranges from 600 to 1,000 mm. a year. In northern Nigeria, for example, sorghum and millets are grown on over 50 percent of the area cultivated (Beeden et al., 1976). In the Savanna region of West Africa,[1/] sorghum is generally grown in a bush fallow land use system and is frequently intercropped with millet. Sorghum is generally dominant in areas susceptible to both drought and flooding while millets, which are extremely drought resistant and tend to store better than other cereal grains, play a major role in zones receiving low and uncertain rainfall. Even in cases where sorghum and millet are not intercropped, farmers often grow several varieties of each crop on different fields in the same year.[2/]

[1/] The term the "Savanna" zone or region encompasses the semi-arid regions of West Africa, including the Sahelian zone, the Sudanian zone, and the northern parts of the Guinean zone where cereals are the main staple.

[2/] Some advantages of growing multiple varieties are: (1) security against crop failure, (2) diet diversity, and (3) spreading seasonal labor requirements.

Maize is the staple grain in many parts of Southern and Eastern Africa. Maize is the most important food crop grown in Zambia, Tanzania, Malawi, and Kenya and it is increasing in West Africa as a replacement for sorghum and millet (Taylor and Bailey, 1979). Maize is also grown as an important secondary crop in many areas, particularly forest zones, and is eaten fresh. Under favorable conditions, maize tends to outyield other cereal grains and is less susceptible to attacks by birds than sorghum and millet. Maize has been found to do particularly well in West Africa in Cameroon, Togo, and Benin.

While sorghum, millet, and maize continue to be the primary staple food grains, rice and wheat are increasing in importance throughout Africa. Madagascar is Africa's largest rice producing nation. Rice is also pervasive in West Africa where it is the staple food in Liberia, Sierra Leone, and parts of Ghana. For example, a 1974/75 survey in Sierra Leone revealed that rice was grown on over 97 percent of the small farms (Spencer and Byerlee, 1976). Rice is grown in four major cropping systems: upland or rainfed, in paddies, in mangrove swamps, and on bottomlands (bas fonds). Upland rice, which accounts for 75 percent of the rice cultivated in West Africa, is generally grown in a bush fallow system and is frequently intercropped with maize, millet, and cassava. Most rice is grown as a subsistence crop. Rice imports have increased dramatically over the last decade in response to growing urban demand. In 1980, for example, West Africa imported 1.6 million tons of rice. A number of studies are now focusing on the reasons for the shortfall in production in a region where land is abundant and unused (Pearson et al., 1981).

The major wheat producing areas are in Ethiopia, Kenya, Tanzania, Lesotho, Zimbabwe, and the Sudan. In these countries, wheat is often the major staple in highlands above 2,100 meters. The majority of the wheat is grown on large farms and is sown and harvested mechanically. In lower areas, there has been little expansion of wheat acreage because of low and unreliable yields. Wheat production is being rapidly expanded on government-directed irrigation schemes in the Sudan, northern Nigeria, Zambia, and in a number of other countries, partly for political reasons and partly because foreign aid encourages wheat production in countries such as Zambia and Tanzania (Freeman, 1980).

In humid forest zones, farmers rely on plantains, roots, and tubers rather than grain for most of their calories. Cropping systems in forest zones are usually dominated by one or two crops. Plantains are the major staple food grown in parts of Uganda, Tanzania, Ghana, Ivory Coast, and Zaire. Plantains may be planted in pure stands but often are intercropped as shade for coffee or with food crops such as maize or beans.

Root crops, primarily cassava (manioc) and yams, are widely grown throughout sub-Saharan Africa. Cassava is growing in importance because it requires less labor than yams and cereals, can be grown in a wide range of climatic conditions, has low soil nutrient requirements, is resistant to pests, and is regarded as a "famine crop" because

some varieties can be left in the ground for several years with no significant deterioration in quality. Many high-yielding varieties of yams are being grown in West Africa, particularly in Nigeria where 90 percent of the West African output and two-thirds of the world output of yams is grown. Yams are labor-intensive and declining in importance in some regions because of rising wage rates.

The major grain legumes are groundnuts (peanuts), cowpeas, and pigeon peas. Cowpeas, which are the most commonly eaten legume, are generally intercropped with cereal grains. Groundnuts are an important cash crop throughout the semi-arid regions but they are also eaten boiled or roasted. Soybeans are a minor crop but are of increasing importance. There are problems of consumer resistance to soybeans and in storing soybean seeds in the dry season in semi-arid regions.

Since the colonial period, African farmers increasingly have produced certain crops primarily for sale (cash crops). Groundnuts and cotton are important cash crops in the semi-arid regions. Cotton plays a major role in Uganda, Tanzania, Malawi, the Sudan, Mali, Upper Volta, Senegal, and northern Nigeria. The most important perennial cash crops are oil palm, cocoa, coffee, tea, pyrethrum flowers,[1/] and rubber. Oil palm is important in Zaire and in the rain forest of West Africa, particularly in the Ivory Coast and Nigeria. Cocoa is an important crop in Ghana, Nigeria, Cameroon, and the Ivory Coast. Coffee is grown by small farmers in Uganda, the Ivory Coast, Cameroon, Kenya, and Ethiopia. Coffee in West Africa is mostly of the Robusta type which is of lower drinking quality and is primarily used for making instant coffee. Most of the coffee in Kenya, Uganda, and Ethiopia is Arabica and is considered to be some of the best quality coffee produced anywhere in the world. Kenya is the center of a flourishing smallholder tea industry.

Farmers grow vegetables such as okra, onions, tomatoes, peppers, and leafy greens on small garden plots to supplement the staples in their diets. Vegetables may also be intercropped with staples. Vegetables are frequently grown on small plots along riverbeds during the dry season. While labor inputs are high for vegetable production, the returns to labor are about the same as most staple crops because of the high value of vegetables. Some vegetables are air freighted to Europe during winter months (FAO, 1976c).

Livestock Systems

Livestock is a major industry in Mauritania, Mali, Niger, and Chad in West Africa; Ethiopia and the Sudan in Eastern Africa; and Botswana in Southern Africa.[2/] Cattle are

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[1/] An environmentally safe but highly toxic pesticide which is grown mainly by small farmers in Kenya, Tanzania, Rwanda, and Zaire.

[2/] References and bibliographies on livestock are R. E. McDowell (1972); Dahl and Hjort (1979); Ergas (1979); and ILCA (1978, 1979a,b,c,d, 1980a,b).

the most important type of livestock in terms of milk and meat consumption but small ruminants (goats and sheep) are dominant in a few countries. For example, small ruminants account for about one-half of red meat consumption in rural Mali (Delgado, 1980) and in the humid zone of Nigeria (ILCA, 1979a).

Sheep and goat production are attractive to small farmers because of low initial investment (relative to cattle) and the corresponding small financial loss with the death of individual animals. Small ruminants can be fed roughages and crop by-products, managed by women and children, and sold to pay school fees and to purchase grain and cloth. Until recently, sheep and goats were neglected by both technical researchers and social scientists (McDowell and Bove, 1977; ILCA, 1979a).

Donkeys and camels are primarily used for transportation and traction in the semi-arid and arid regions. Camels are an important source of milk in some countries. There is relatively little swine production in Africa, particularly in Moslem areas. Poultry are common in rural households and are increasingly produced in specialized units around large cities.

There are many arbitrary methods of classifying livestock production systems. We shall use the following: (1) nomadism or total pastoralism, (2) semi-nomadism or semi-pastoralism, (3) sedentary pastoralism, and (4) ranching--private, group, association, cooperative, and state.

Nomadic households are defined as those which do not have a permanent place of residence or practice regular cultivation. Nomadic and semi-nomadic households have historically migrated through arid and semi-arid regions in search of water and grazing land and have played a major role in regional trade--especially in West and East Africa (Salzman, 1980). Pastures are traditionally considered to be available to all members of an ethnic group or are rented under land use agreements. The priority of nomads is to feed their families a continuous supply of milk and meat from their herds. Nomadic pastoralism is presumed to be declining[1/] in most countries because of (1) the loss of prime grazing areas to semi-nomadic herders and to farmers, (2) arid livestock zones have become relatively overpopulated, forcing a reduction in distance covered by transhumance,[2/] and (3) recurring drought.

[1/] But Stephan A. Sanford of the O.D.I. points out that it is unwise to generalize because to test this proposition one needs data on the (a) area used by nomads, (b) number of nomads, (c) number of livestock, and (d) length of nomadic moves. Moreover, the length of moves and the area of land used by nomads vary enormously from year to year depending on rainfall (personal communication, March 17, 1981).

[2/] Transhumance refers to the pattern of regular movement of cattle and herders in search of grazing land. For a classic study of transhumance in northern Nigeria and Niger, see Stenning (1957).

Semi-nomadic pastoralism is a system in which households establish a permanent place of residence which is kept for several years. Crops are cultivated as a supplementary food source but herds are moved on transhumance to assure sufficient forage and water. But in some semi-arid areas, nomads have acquired use rights to dry season grazing areas such as in the Niger Delta in Mali (Gallais, 1975).

Sedentary pastoralism and mixed farming are systems of integrated crop and livestock production. Sedentary pastoralism refers to permanent settlers who grow a few crops but rely on livestock production as their dominant enterprise. Mixed farming refers to a system whereby crop farmers add a livestock enterprise either for fattening or for the use of oxen in cultivation and the subsequent fattening of the cull work oxen. The integration of crops and livestock has a long history dating from schemes introduced by colonial governments in the 1920s. Mixed farming is expanding but its success is crucially dependent upon the presence of a cash crop such as cotton and groundnuts.

Systems of stratified production and ranching are alternatives to the dominant system of pastoral production (FAO, 1977). Stratification involves removing young male stock from the arid and semi-arid pastoral areas for fattening in the intermediate rainfall zones and eventually for sale in urban centers. Stratification and industrial feedlots are not widespread in West Africa because of the risk involved in securing a steady supply of animals for fattening and in the fluctuation of the price of the finished steers.

Ranching has been practiced for decades in Zaire, Angola, and Eastern and Southern Africa, and to a lesser degree in some countries in West Africa. During the 1960s and early 1970s, ranching was endorsed by many experts and donors because ranching was thought to (1) prevent overgrazing through the control of the number of animal units and the practice of on-ranch rotational grazing, (2) prevent spreading of contagious disease, (3) guarantee a supply of cattle to markets, and (4) provide a demonstration function for small herders. But in recent years, the push to establish ranches has slowed in light of evidence that the number of jobs created and the returns on investment are low (Von Kaufmann, 1976). Moreover, concerns for equity are encouraging governments to help small herders form ranching associations and group ranches (Ayuko, 1980, 1981).

Dairy production is concentrated in the eastern African region in Kenya, Tanzania, Ethiopia, and the Sudan.[1/] Although colonial policy in Kenya reserved dairy production for large-scale farmers (mostly white), smallholder milk output has grown rapidly over the past 20 years and it now accounts for 40 percent of Kenya's milk output. Some nomadic groups such as the Fulani in western Africa supply milk to local villages.

[1/] The small number of economic studies of dairying include Zalla's (1981) study in Tanzania and Hopcroft and Ruigu (1976), Ruigu (1978), and Stoltz' (1979) studies in Kenya.

II. HISTORICAL AND THEORETICAL PERSPECTIVES

Since all the countries in this review, with the exception of Ethiopia and Liberia, are former colonies of France, England, Germany, Belgium, or Portugal, we shall begin by examining precolonial economic activity and the links between colonial policies and agricultural policy during the postindependence period. We then present an overview of the main theoretical perspectives influencing scholars and policy makers. There has been a lag in efforts to develop theories of development based on African values, institutions, resource endowments, and data. Currently, two streams of thought--western development economics and dependency/political economy models--dominate political debates, research, and policy analysis in Africa.

Historical Perspective

Precolonial Economic Activity: 1800 to 1880s

Until recently, African history was essentially colonial history and, more specifically, the political history of the colonial powers starting around the 1880s. Economic historians devoted little attention to the precolonial period because they assumed that the development of Africa began with the imposition of colonial rule. Many scholars such as Peter Bauer (1975) of the London School of Economics have argued that modern social and economic life in Africa began with colonial rule and the creation of trade linkages with Europe. But over the past 20 years, there has been an explosion of research on the history of the precolonial period from 1800 to 1880. There is now convincing evidence that extensive economic activity was taking place throughout Africa prior to the beginning of colonial rule in the 1880s. The standard reference to the economic history of the precolonial and colonial periods is McPhee's The Economic Revolution of British West Africa (1971). Although McPhee called the rapid expansion in export crops a "revolution" which was facilitated by the imposition of British rule starting in the 1880s, he carefully traced the origins of the revolution to the 1820s.

A Swedish economic historian, Sundstrom has made a major contribution to the economic history of the precolonial period. Sundstrom's book was published in Swedish in 1964, going virtually unnoticed until it was translated and published in English (1974). He drew on English, French, German, Dutch, Portuguese, and Swedish sources in his penetrating analysis of the internal trade of salt, textiles, iron, copper, and brass in West, Central, and East Africa from the eighteenth to the twentieth centuries. Evidence that internal trade was widespread, and of great antiquity, is also supported by Dike's (1956) study on oil palm trade in the Niger delta of southern Nigeria in the nineteenth century

and Lovejoy's (1980) research on long-distance kola nut[1/] trade in the nineteenth century. A. Cohen (1971) traces the origins of long-distance livestock trade in West Africa to the eighth century and highlights the central role of Islam as the binding force of a network of traders scattered over a wide area encompassing several countries. Baier (1977) points out that for many centuries long-distance traders have played a major role in the economies of West Africa by moving salt, dates, and livestock from the desert and savannah zones into the more fertile land on the coast and grain, cloth, gold, and manufactured articles from the coast to the savannah and desert zones. The net impact of the above studies is that they have essentially demolished the view that economic development in sub-Saharan Africa began with the arrival of colonial governments in the late 1880s.

A. G. Hopkins, an economic historian at the University of Birmingham, established himself as a controversial and influential scholar with the publication of An Economic History of West Africa (1973). Hopkins used neoclassical economic theory and a modified formalist paradigm of economic anthropology in his analysis of the interaction between internal trade and external market forces over the 1800-1950 period. Hopkins' grand theme was that market forces played a key role in integrating West Africa into the world economy. Although colonial rule did not begin until the 1880s, Hopkins pinpoints the large increase in agricultural exports in the early 1800s as the beginning of "modern West African agricultural development." Hopkins' book has been acclaimed by scholars in numerous disciplines but attacked by George Dalton, a Northwestern University economic anthropologist and leader of the substantive paradigm of economic anthropology. In Dalton's (1976) 50-page review of Hopkins' book, he criticized the emphasis on the market as the major force in development in the nineteenth century. Dalton contends that reciprocity and redistribution were also important forces in the precolonial and colonial periods.

The slave trade is at the heart of West African history. The late Walter Rodney argued in How Europe Underdeveloped Africa (1974) that a European imposed pattern of exchange of slaves for manufactured goods from the 15th through the 19th centuries was the cause of the underdevelopment of Africa. Rodney argued that the slave trade reduced Africa's population growth rate to zero and caused a severe technological arrest (although Rodney neglected to explain how population growth leads to technical advance).

Now that economic historians have documented the presence of extensive international trade and the growth of cash crops before the advent of colonial rule, there is a need for micro research on the agricultural history of particular crops, the origins and

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[1/] A nut with a caffeine base. Kola is chewed as a stimulant and used in ceremonial functions such as welcoming guests.

dynamics of internal trade, and the linkages between internal and international trade. Carolyn Barnes' study (1979) of the agricultural history of coffee production among the Gusii in Kenya over the 1933-1948 period and Baier's analysis (1980) of the economic history of the central region of Niger from 1850-1960 are examples of the type of in-depth research which is needed.

The Colonial Period: 1880-1960

An analysis of agricultural development in the postindependence period since 1960 should be rooted in an understanding of colonial strategies. Colonial strategies varied widely throughout Africa and it is difficult to generalize about the impact of these strategies on the countries included in this review. British colonial policy in Kenya, for example, promoted extensive European settlements. Sorrenson's (1967) assessment of Kenyan agriculture during the colonial period reveals that much of the best land was reserved for Europeans starting in the late 1890s. Head taxes were introduced to encourage small farmers to produce cash crops and to sell their labor to European plantations and mines. On the other hand, British colonial policy in Nigeria, Ghana, the Gambia, and Sierra Leone sharply restricted plantation development and settlement by white farmers. In fact, British colonial policy in Nigeria prevented private plantations from gaining long-term control over land and large firms such as Unilever gave up on trying to establish plantations in Nigeria and eventually opened plantations in the Belgian Congo (now Zaire). For a reference on British colonial policy in Africa, see Hancock (1942).

In contrast to British policy which restricted settlers and plantations in Nigeria, French policy encouraged Europeans to establish plantations to grow coffee and cocoa in the Ivory Coast (B. Campbell, 1974). In addition, the decrees of 1925 regulated forced labor and ensured a steady flow of Ivorian workers for the European plantations. Gradually, Ivorians started to grow coffee and cocoa on small plots scattered throughout the forest but since they used European techniques they were called planters. The Ivorian planters led the drive to independence after World War II and the planters remain a powerful political force in the Ivory Coast today. For a discussion of French colonial policy in West Africa, see Newbury and Kanya-Forstner (1969).

In Tanganyika (now Tanzania), the thrust of German colonial and commercial policy from 1905-1912 was to develop plantation agriculture. Hut and poll taxes were imposed to force Africans to provide wage labor for the plantations. Iliffe (1979) has shown that by the end of German rule in 1912 an export orientation was firmly established.

An important assessment of colonialism is Duignan and Gann's collection of papers, The Economics of Colonialism (1975). Papers include an analysis of trade policy by Meier,

the emergence of cash crop exports by Hogendorn, industrialization by Kilby, French colonial policy by Thompson, agricultural research by Yudelman, and British colonial policy by P. T. Bauer and a synthesis by the editors, Duignan and Gann. The editors and most of the authors generally present a procolonial assessment of the contribution of colonialism to African development. For example, Gerald Meier (1975) argues that the slow rates of economic growth during the colonial period should not be attributed to the fact that exports were primary products, rather it might have been due to the "absence of more active policy making" by colonial governments. Studies of the colonial period include Hill (1963), Suret-Canale (1971), Wrigley (1965), de Wet (1977), Brett (1973), Dorward (1975), Yansane (1976), Baier (1977), Dumett (1971), Green and Hymer (1966), Brooks (1975), Howard (1978), and Kitching (1980).

Since agricultural development programs in the postindependence period have been directly or indirectly influenced by colonial policies, approaches, and attitudes about agriculture's role in development, it is important to examine the following:[1/]

(1) The degree to which Africans were excluded from or "forced" to participate in selected colonial development programs;

(2) The colonial record on the training of Africans;

(3) The colonial position on promoting research on export vs. food crops;

(4) Who benefited from colonial land grants and the surpluses generated from export agriculture?

A growing number of scholars have revealed that Africans were systematically excluded from participation in many colonial development schemes and in producing certain export crops and improved cattle. R. E. Baldwin's (1966) study of export growth in Zambia (then Northern Rhodesia) from 1920-1960 reports that "the agricultural policy for most of the period covered was designed to benefit European settlers. African farmers were either ignored or discriminated against when their interests conflicted with those of the European population . . . and those few agricultural measures specifically directed toward helping African farmers were often poorly conceived and ineffective" (R. E. Baldwin, 1966). Reviewing colonial policy in Kenya, Heyer and Waweru (1976) state that "there was an effective prohibition on African coffee growing until 1933 when it was allowed on a very limited and experimental scale in three districts relatively far removed

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[1/] Several other issues also could be examined including the colonial infrastructure strategy which developed railroads and roads to link favorable natural resource zones to coastal trading centers. This explains why there are still no major rail and road links along the coasts of East and West Africa.

from European coffee growing." For further evidence on how colonialism excluded Africans from growing a number of crops and from producing improved cattle, see Uchendu and Anthony (1975a,b).

A number of scholars have documented how the colonial governments compelled village chiefs to force farmers to grow selected crops (e.g. cotton), or to "contribute" labor to maintain roads. Magasa (1978) presents a damming account of the repressive policies adopted by the French colonial service to recruit labor for government projects such as the Office du Niger irrigation scheme in Mali. The colonial legacy of top-down approaches to agricultural change is still present in agricultural ministries in many independent African countries.

Colonial governments gave little attention to the training of Africans. McKelvey's survey of "Agricultural Research in Africa" (1965) reports the almost total failure of colonial governments to develop institutions for training African agricultural scientists and managers. For example, by the time of independence in the early 1960s, there was only one Faculty (College) of Agriculture in French-speaking tropical Africa. Between 1952 and 1963, only four university graduates in agriculture were trained in Francophone Africa and 150 in English-speaking Africa. Johnston (1964) observed that there were only three African scientists working in all the experimental stations in the East African countries of Kenya, Uganda, and Tanzania in 1964. Lele (1981) reports that training has been given such low priority during the 20-25 years of postindependence that Africa has failed (unlike India) to develop a proagricultural lobby of professional agricultural scientists, planners, and administrators.

One of the most important legacies of the colonial era is the bias against research on food production and on small farmers and herders. In numerous countries, colonial regimes focused their research and development programs on export crops, plantations, and land settlement schemes. For example, Hunt (1975a) reports that millet yields in 1972-73 in Kenya were at best only 50 percent of the maize yields and that "No (agronomic) work has been done on developing improved bulrush millet or finger millet strains" in contrast to a large amount of research on maize which was initiated during the colonial period to benefit the white settlers in the highlands areas with high rainfall. Heyer (1975) reports that colonial policy in Kenya, which established export crops in areas with the most favorable natural resource endowments, helps to explain some of the regional inequalities and the fragmented road and railroad systems. Although the number of European farms was never very large in Kenya, reaching a maximum of 3,600 holdings at the end of the 1950s, Heyer reports that "the development of Kenya's agriculture was profoundly affected by the presence of white farmers" because at the end of the 1950s

European farms were responsible for an estimated 80 percent of the agricultural output that reached urban and export markets (1981, pp. 93-94).

Economic historians have only recently started to grapple with the roots of rural poverty in Central and Southern Africa. Palmer and Parson's collection of essays, The Roots of Rural Poverty in Central and Southern Africa (1977), has been described by Ranger (1978) as a "landmark in African agricultural and peasant studies." The theme of the book is the alleged "strangulation" of peasant (smallholder) farming by the capitalist market forces which first stimulated peasants to produce for the market and sell their labor to the mines but later resulted in the exploitation of farmers through the taxation of export crops. Although Ranger lauds Roots, he urges historians to shift from archival research to more field studies and oral history to document how small farmers in Central and Southern Africa were affected by specific colonial policies. Another important study is Bundy's The Rise and Fall of the South African Peasantry (1979).

Any definitive assessment of the colonial period is faced with the unanswerable question of what would have happened in the absence of colonialism. Until recently, numerous scholars accepted at face value the development programs initiated in the colonial period, while ignoring the broader question of possible exploitation. For example, two scholars recently lamented the narrow approach to their doctoral dissertation research. Brett, a U.K. political scientist, reflected on his doctoral dissertation research on colonialism in Kenya as follows:

> In London I worked in the general ethos of the Institute of Commonwealth Studies where the tendency in Colonial History was towards a thorough empiricism in a framework which did not question the overall validity of Britain's colonial contribution to African development except where extensive resettlement (e.g., encouragement of white farmers to settle in Kenya) had been allowed. This environment certainly encouraged me to take at face value a great deal in the material which I was given and did not lead me to make any serious attempt to relate it to the broader questions of colonialism and underdevelopment which have now forced themselves into the center of all serious work in this general field. (1973, p. ix)

An American anthropologist, Sudarkasa, wrote in the preface to a book based on her dissertation on market women in Nigeria:

> When I wrote this study a decade ago, I tacitly gave support to the social science fiction that what happened in Nigeria (and in all of Africa) in the 20th century could be sanguinely described in terms of 'modernization', and that the processes of European entrenchment and exploitation in Africa could be subsumed under the benign if not indeed benificent concept of 'development'. The fact that I did not delve into the factors underlying the conditions described in this study is perhaps an indication of the success of my training in Western social science. In any case, suffice it to say that I would bring a decidedly different perspective to such an undertaking if I were doing it today. (1973)

In summary, although the full impact of the colonial policies on contemporary Africa will require further research, the debate has been joined. Research on the colonial period by neo-classical economists is now being supplemented by a growing number of political economy studies of trade, capital formation, and the uses of surpluses. There is a rich agenda for research by economic historians of diverse ideological positions. For example, why has export growth in some countries, e.g., the Ivory Coast, been cumulative and why do other countries such as Ghana, Zambia, and Senegal remain dependent on one export crop after 60 years of export trade? Future research on the colonial period is likely to show that the net effect of the colonial policies and programs on the peoples of sub-Saharan Africa will be somewhere between Peter Bauer's assertion that "virtually all components of modern social and economic life in Africa date from the colonial period" (1975, p. 653) and Kwame Nkrumah's assessment that "without exception they (the colonial powers) left us nothing but our resentment" (1963, p. xiii).

Transition to Independence

As African nations became independent in the late 1950s and early 1960s, most of them pursued mixed economies with a heavy emphasis on foreign aid,[1/] nation-building, industrial development, education, and diversification of their economies. A small number of countries such as Mali, Ghana, and Guinea shifted abruptly to revolutionary socialism in the early 1960s. But whether political leaders were espousing capitalism or socialism they generally all gave low priority to agriculture. African leaders generally viewed agriculture as a "backward" sector which could provide agricultural surpluses--taxes and labor--to finance structural change and industrial/urban development. Agricultural policies in many capitalist and socialist countries supported plantations, state farms, land settlement schemes, and the replacement of private traders and money lenders with government trading corporations and credit agencies. Moreover, the empirical record shows that all countries under all types of governments--civilian, military, capitalist, and socialist--have exploited and controlled the agricultural sector via (1) harsh taxation policies and the underpricing of agricultural commodities; (2) concentration of secondary schools, hospitals, and other social services in the capital city, or several large cities; (3) top-down pattern of government-imposed agricultural development schemes; and (4) unwillingness to transfer the administration of marketing, storage, and credit programs to groups of farmers. Among the reasons for the low priority given to agriculture in the

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[1/] For example, one of Africa's most respected economists, Tom Mboya (1967) of Kenya, laid out a development strategy for Africa which called for "a massive inflow of capital over perhaps 30 years and an equally massive inflow of technical assistance personnel over 10 to 15 years." Kenya's President Kenyatta encouraged investors "to bring prosperity" to Kenya.

1960's were the following: (a) industrialization was perceived to be the most expedient way to bring about structural change, a high rate of economic growth, and economic independence; (b) investment in food production was assumed to be unnecessary because of low man-land ratios and surplus land; and (c) export crops were perceived to be "colonial" crops which contributed to dependency and price and income instability.

During the last decade, almost all African governments have shifted from industrialization, export promotion, and agricultural transformation to espousing the multiple goals of food self-sufficiency, improved nutrition, diversification of their economy, increased trade within Africa, economic growth, and increased access of the poor to employment, income, and social services. While nearly all African governments espouse the primary goal of self-sufficiency in food production, objectives such as self-sufficiency are free. It takes resources to increase food production and it will involve some difficult production/equity conflicts (e.g., conflicts between regions with good agricultural potential and regions with poor potential). Thus, as African nations enter the third decade of the postindependence period, the 1980s, there is generally little debate over the goals of development. The contentious issues are priorities, financing, time frame, the role of agriculture, and the state in national development.

Theoretical Perspectives

Scholars working within Africa on development problems over the past 30 years have been caught in a cross-fire of imported models and theories of development. The lag in developing models of development by Africans and based on African data and institutions is linked to the token role which colonial governments gave to the training of Africans for positions in universities and research organizations.[1/] As a result, the production of knowledge about African development still remains to a substantial degree in the hands of expatriates except in a few countries such as Nigeria and Kenya. Moreover, expatriates dominated planning agencies and social science research institutes in Africa throughout the 1960s and most of the 1970s. For example, the Economic Commission for Africa (ECA) in Addis Ababa relied heavily on expatriate advisors such as A. F. Ewing and Rene Dumont to provide the vision for ECA in the 1960s. But these ECA advisors failed to articulate feasible development strategies for an agrarian-dominated continent. For example, A. F. Ewing reported that "industry is the sole means of raising the productivity of an economy" (1968, p. 11). An influential UN/ECA/FAO report on agriculture called for "an accelerated movement into market agriculture through government measures

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[1/] The lack of African staff is still a critical problem in African universities. For example, in August 1981, a total of 14 of the 16 resident faculty members in the Department of Economics at the University of Dar es Salaam were expatriates.

aimed at both individual producers and large-scale projects" (1964, p. 39). But as we point out later, large-scale projects have generally been ineffective in achieving both efficiency and equity objectives.

The Executive Secretary of the United Nations Economic Commission for Africa, R. K. A. Gardiner, requested the noted French agronomist, Rene Dumont, to undertake a survey in order to initiate debate on how to transform African agriculture. In his report entitled African Agricultural Development (UN/ECA/FAO, 1966), Dumont recommended cooperative farming and lifelong claims to land rather than private ownership of land and he urged African nations to learn from the Socialists' experiences in Eastern Europe, USSR, China, and Cuba. But throughout the report, Dumont moralized about the need for Africans to work harder and the need for austerity, integrity, education, and exemplary moral qualities.[1/]

The contrast between Africa and Latin America in producing knowledge about development problems and strategies is striking. In Latin America in the 1950s and 1960s, Latin American scholars such as Prebisch, Dos Santos, Furtado, Sunkel, and Pinto produced a number of seminal papers and reports for the United Nations Economic Commission for Latin America (ECLA).[2/] These scholars, under the leadership of Prebisch, came to the conclusion that models on development based on the experience of high-income countries in Western Europe and North America, including "classical" Marxist models, were not relevant to Latin American conditions and that attention should be directed to developing theories and models based on Latin American conditions. Moreover, Prebisch's (1959) influential thesis that the world economy is rigged against the Third World--declining terms of trade--was one of the central issues in the North-South meeting of 22 Heads of State in Cancun, Mexico in October 1981. The Prebisch thesis remains an article of faith in the Third World.

As African nations became independent in the early 1960s and Western economists assumed important roles in helping to prepare development plans and serving as policy advisors, naturally questions were raised about the usefulness of Western economic theory. One of the recurring debates in the 1960s centered on the economic motivation of farmers and traders in subsistence economies. Another major issue was the relevance of Western development models--dual-sector, labor surplus, land surplus, and stages of growth models.

[1/] Dumont's moralizing about the shortcomings of African leaders and the lack of hard work in African society is a common theme in Dumont (1966, 1969) and Dumont and Mottin (1980).

[2/] For a synthesis on Latin American scholarship on economic development in the fifties and sixties, see Alain d'Janvry (1982).

Economic Behavior of Farmers and Traders

Many Western economists have long contended that Africans were not "economic men" in the Western sense. For example, one hundred years ago, Alfred Marshall, the founder of neoclassical economics, wrote about the savages "living under the dominion of impulse; scarcely ever striking out new lines for themselves; never forecasting the distant future; fitful in spite of their servitude to custom, governed by the fancy of the moment; ready at times for the most arduous exertions, but incapable of keeping themselves long to steady work" (Marshall, 1956). A major implication of this view is that Western economic theory may have little to say about the behavior of farmers and traders in Africa.

It is instructive to note that this theme has been hotly debated in the literature of several disciplines, including sociology, anthropology, and political science. One of the first challenges to the notion that Western economics can be applied in low-income countries came from the Dutch sociologist Boeke. On the basis of many years of research in Indonesia, Boeke (1953) advanced the concept of sociological dualism to describe the modern and traditional sectors in which the peasants in the traditional sector had limited needs, a value system based on prestige, and they exhibited fatalistic behavior and backward-bending supply curves of labor. As a result, Boeke asserted that Western-financed development interventions in the traditional sector would be constrained by these social and cultural barriers to change.[1/]

In the 1950s and 1960s, the debate over the relevance of Western economics in developing countries preoccupied many economic anthropologists. During this period, economic anthropologists were divided into two schools of thought--the "substantivists" and the "formalists." The substantivists contended that exchange in many low-income countries is carried out according to principles of reciprocity and redistribution. As a result, the substantivists contended that Western economic theory which stresses profit maximization has limited application in many parts of the developing world, including Africa. The substantive paradigm is conveyed through the writings of Polanyi et al. (1957) and Dalton (1962, 1978).[2/] The formalist paradigm was articulated by economic anthropologists such as Raymond Firth and Harold Schneider (1974). The formalists contended that Western economic theory could be selectively applied to the Third World

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[1/] But as Benjamin Higgins (1959) and other scholars observed, Boeke did not present solid evidence to defend his case.

[2/] Pryor (1977) used econometric techniques to test 60 hypotheses about "primitive and peasant societies" in a number of case studies and found that most of the hypotheses of the substantive school were not supported. But one has to question the use of econometric techniques to test the validity of the substantive paradigm.

including Africa, because African farmers, traders, and migrants were believed to respond in a general way to economic incentives just as producers and consumers respond in high-income market economies.[1/] Fortunately, the often sterile debate between the substantivists and formalists was relegated to the "dust-bin of history" during the 1970s. Anthropologists generally reached a consensus that many of the views of both schools were not mutually exclusive and that each school could provide hypotheses which shed insights on economic behavior in agrarian societies in the Third World.

The debate over the economic behavior of farmers has recently reemerged among political scientists working in Asia. J. C. Scott (1976), for example, has advanced the view that peasants are concerned with village cohesion as a means for assuring economic security and survival. In Scott's view, the transition to a market-oriented economy is likely to increase inequality and increase the insecurity of the poorest families in a village. Joel Migdal (1974) has also stressed the importance of a village orientation in decision making and the possible destruction of village safety nets as commercialization of agriculture proceeds. Scott's and Migdal's view of a "moral economy of subsistence farming" was challenged by Popkin in The Rational Peasant (1979). Drawing extensively on historical data from Vietnam from precolonial times to the emergence of the Communist movement, Popkin contends that peasants make individual investment decisions which may be at the short-run expense of the village. Popkin is of the opinion that the commercialization of agriculture, rather than increasing inequality and insecurity, presents opportunities for peasants to increase their welfare.

The debate over the extent to which the behavior of farmers and traders in low-income agrarian countries are influenced by "non-economic" considerations will likely never be fully resolved. But the proposition that farmers and traders in Africa act in a manner which is inconsistent with the postulates of Western economic theory is an empirical question. During the colonial period and the first decades of independence, the view that Africa's farmers were not "economic men" was reflected in (1) the target income concept and the hypothesis that there was a backward-bending supply curve for labor, and (2) the hypothesis that social and cultural factors are overriding barriers to the adoption of innovations and the achievement of development objectives. We shall review the literature on these two propositions.

[1/] The debate between the formalists and the substantivists has been summarized by Posner (1980, pp. 608-609) as follows: "the formalists spend their time looking for explicit markets in primitive societies and the substantivists spend their time showing how resources in primitive societies are mostly allocated by non-market means."

Target Income/Backward Bending
Supply Curve of Labor

The origins of the target income or backward-bending supply curve of labor hypothesis can be traced to the colonial period when plantation and mine owners reported that they could not fill their vacancies at going wage rates because Africans were "lazy" and that mine workers would often return to their families after they had earned their target income. This view was implicitly and, in some cases, explicitly supported by colonial administrators. For example, head taxes were introduced in numerous colonies to force Africans to increase their supply of labor to plantations and mines. In the postindependence period of the 1960s, numerous scholars repeated the theme that Africans had limited wants and that they would not respond to market forces--higher wages, for example--after they had earned a specific money or target income to pay for taxes, bride-price, or consumer goods. Under this line of reasoning, it was assumed that a 5 percent increase in wages, for example, might lead to a reduction rather than an increase in the supply of labor. The policy implication was that higher wages and higher prices to farmers could not be relied upon to draw workers into the labor force and farmers into the market economy. But during the 1950s and early 1960s, economists and agricultural economists began to marshall an impressive array of empirical findings that Africans responded "normally" to economic incentives such as changes in seasonal wages and relative prices.

Two U.K. economists--Bauer and Yamey (1959)--were among the first researchers to present quantitative evidence on the response of small farmers to price incentives. Bauer and Yamey examined two of the statutory marketing boards which were established in Nigeria during and after World War II--the Nigerian Cocoa Marketing Board and the Nigerian Oil Palm Produce Marketing Board. Starting in 1947-48, these Boards offered large differentials in prices paid to farmers in order to encourage the production of higher grades of cocoa and oil palm. Bauer and Yamey's study revealed that the proportion of Grade I cocoa purchased by the Nigerian Cocoa Marketing Board increased from 47 percent in 1947-48 to 98 percent in 1953-54 following the introduction of premium prices for high quality cocoa. Bauer and Yamey demonstrated that the small Nigerian cocoa and oil palm producers were indeed "economic men" and that they responded to market incentives just as farmers in high-income countries had been doing for decades.

William O. Jones' (1960) masterful survey of studies of migration, trade, production, and marketing in the precolonial and colonial periods produced impressive evidence that "the economic drive is present in a great many Africans." Peter Kilby (1961) studied Nigerian factory workers and found that they surpassed their European counterparts in sheer physical exertion by as much as 50 percent when the proper financial rewards were

held out to them. Elliott Berg (1961) presented added evidence to suggest that the target income/backward-bending supply curve of labor hypothesis should be discarded. Moreover, Miracle and Fetter (1970) argued that even if a backward-sloping, labor-supply schedule had been validated by empirical studies this behavioral pattern could be consistent with orthodox economic behavior if all of the costs associated with migration and working were taken into account--costs such as uncertainty, disease, and long period of separation from their families. Miracle studied the emergence of the wage labor force in Kenya in the early 1900s and found that migrants who left the highlands of Kenya for work 300 miles away on the coast encountered substantial risks of contacting disease, not receiving wages when they became ill, being subject to brutality, and even death. Miracle concluded (1976) that the costs associated with migrants leaving their families could have produced a backward-bending supply curve of labor in this particular case. Helleiner (1975) and Miracle (1976) summarized the debate by noting that it is doubtful that the target-income hypothesis was ever valid for a large number of Africans, but, even if it was, it is of limited validity today.

The Cultural Barrier Hypothesis

In the early 1960s, it was common to identify social and cultural factors as overriding barriers to the adoption of innovations and the achievement of development objectives. But the failure of the Community Development movement in Asia in the 1950s and 1960s[1/] (which stressed social factors--such as felt needs, participation, and self-help) and numerous examples of change in spite of perceived social barriers have led to a consensus that the cultural barrier hypothesis--like any single barrier theory--should be rejected.[2/]

Turning to Africa, in a major study of agricultural change in six countries in sub-Saharan Africa, Uchendu, an anthropologist, and Anthony, an agronomist, concluded that there is no empirical support for the widely held belief that traditional values constitute a general barrier to change (Uchendu, 1968; Anthony and Uchendu, 1974; Uchendu and Anthony, 1975a,b). This same point is reiterated by Hutton and Cohen in their reassessment of sociological approaches to the study of change among peasants in Latin America and Africa. To quote:

> Local suspicions, jealousies, ignorance, fatalism, passivity, and fears can play their part, just as they can in any human situation, but we no longer use them as general explanations; they can be relegated to their proper place, enabling us to understand why sometimes they impede change and sometimes they do not. (1975, p. 28)

[1/] See Holdcroft (1978).

[2/] See Streeten (1972) for an insightful note on the vacuity of theories of single barriers to change.

Although social and cultural factors may not be a general barrier to change in rural areas in the Third World, it is obvious that these factors still play significant roles in shaping the overall pattern of development and who gains and who loses in the process. For example, Parkin (1972) points out the enduring role of custom in village life of the Giryama society on the coast of Kenya over a 25-year period. Parkin, a social anthropologist, showed how the Giryama shifted from primarily subsistence farming and herding to dependence on the cash economy through the production of copra which was prepared from coconuts. Parkin found that successful farmers deliberately kept themselves from appearing to rise above their neighbors by participating in such customs as bridewealth transactions and reciprocal funerary obligations while at the same time they were purchasing land from small farmers who were forced to sell land to pay for the escalating costs of funerals and bridewealth.[1/] Philip Mbithi (1977) similarly has shown that in East Africa the social environment, including observance of rituals and taboos, is a major influence on the timing of agricultural practices such as planting and harvesting.

Synthesis

In summary, the target income/backward-bending supply curve of labor hypothesis was discredited by empirical studies in the 1960s and 1970s.[2/] As one looks back upon the debate, it is surprising to find the proponents of the hypothesis did not present empirical evidence to support their position. The debate was carried on for years through an exchange of hearsay and assertions. Nor is there any support for the view that social and cultural values are an immutable barrier to change. But we must be cautious about generalizing about the relative importance of social and cultural factors in some 1,000 ethnic groups in sub-Saharan Africa. There are many isolated villages where poor transportation is still a constraint on the operation of market forces. Moreover, there are many nonmarket institutions such as the extended family, clans, and age groups which still play a significant role in shaping economic decisions. But there is unambiguous evidence that African farmers, traders, and migrants will respond to economic incentives when they are offered appropriate incentive structures.

Western Development Models

Although Western development economics is now 25 years old, one thing is clear--it is still unencumbered by evidence from Africa. For example, although aggregate data

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[1/] We are indebted to Sara Berry for calling Parkin's study to our attention.

[2/] For further evidence supporting the concept of economic man in Africa, see the overview of "Supply Response (Function)" studies in Part IV and the discussion of research on livestock in Part VI.

from 101 countries are included in Patterns of Development: 1950-70 (Chenery and Syrquin, 1975), the poor quality of data enabled them to use only 8 African countries in their detailed analysis of the patterns of development. Moreover, dual-sector and stage-of-growth models which dominated Western development economics in the 1960s and 1970s were primarily based on patterns of development, resource endowments, institutional structures, and empirical findings from Asia and Latin America. For example, the well-known dual economy models of Lewis and Fei and Ranis depend on surplus labor, institutionally determined agricultural wage rates, and the assumption of a closed economy. While these models may have provided insight into the interaction of agricultural and industrial development in Asia and Latin America, they shed little light on patterns evolving in the rural economies of Africa.

Vent-for-Surplus

Myint's vent-for-surplus model which focuses on the role of international trade as an "engine of growth" in subsistence economies[1/] has been used to explain the rapid growth of agricultural exports during the colonial and postindependence periods in Africa. Myint, an economist at the London School of Economics, abandoned the traditional classical assumptions such as specialization and comparative advantage in certain crops in trying to explain the sudden surge in exports in some countries such as Burma, Nigeria, and Ghana in the late 1800s and early 1900s. Myint developed a vent-for-surplus model which directly attributes the export boom to improved local transport, access to overseas markets, and incentive goods from overseas. These factors provided a "vent" to tap the surplus-productive capacity inherent in surplus land and family labor after subsistence food needs of farm families had been met.

The vent-for-surplus model is appealing because it is not a global theory of development like stages of growth and dual sector models. The model stresses the key role of effective demand from European markets in mobilizing surplus labor and land in underpopulated areas with a peasant (smallholder) type of production system.[2/] It is presumed to be a costless type of growth which could be largely self-financed by small farmers and local traders by reducing their leisure time. Governments or private international firms only have to provide improved transport, communication, and access to overseas markets.

[1/] Starting in the late 1800s and early 1900s, there was a rapid growth in the production and international trade of crops such as cocoa, coffee, oil palm, and rubber throughout Africa. Many scholars contend that cash crop expansion through international trade was the "engine of growth" of African economies during the colonial period.

[2/] The economic historian's emphasis on the role of international demand for export crops in the study of the African history is a healthy contrast to the modest attention to demand parameters in Western growth models in the past 25 years.

Szereszewski's (1961) and Polly Hill's (1963) research on the rapid growth of smallholder cocoa production in Ghana in the 1880s and 1890s are empirical tests of the vent-for-surplus model. Hill's meticulous field work in southern Ghana revealed that the emergence of cocoa production involved more than a response to growing European demand for cocoa and improved transport in Ghana. Hill found that migrant farmers--not local small farmers--were the source of innovation in cocoa farming through their leadership in organizing, financing, producing, and marketing cocoa. The spread of cocoa farming by migrants can be viewed as a process of indigenous capital formation in a land surplus economy. Migrants were also instrumental in the diffusion of cocoa production in the Ivory Coast (Dupire, 1960) and in Western Nigeria (Berry, 1975). Although Berry (1975) and Hogendorn (1975 and 1978) agree with Myint that increased effective demand provided incentives for smallholders, they contend that Myint's vent-for-surplus model needs to be refined to devote more attention to the role of local institutions in facilitating capital formation and the spread of innovations. Also the vent-for-surplus model of development does not explain why short spurts of export-led growth have led to cumulative growth and diversification of economies such as Australia, New Zealand, and Canada while the cocoa export boom in Ghana and copper exports in Zambia have not led to a reduction of dependence on one key export.

The vent-for-surplus model has been used directly or indirectly in the following studies: cocoa in the Ghana (Szereszewski, 1961; Hill, 1963); cocoa in Nigeria (Berry, 1975); groundnuts (peanuts) in Nigeria (Hogendorn, 1978); rubber in Ghana (Dumett, 1971); peanuts in Senegal and the Gambia (Brooks, 1975); and kola nuts in West Africa (Lovejoy, 1980; Agiri, 1977). For a summary of studies using the vent-for-surplus model to analyze the growth of agricultural exports before 1914, see Hogendorn (1975, 1978). For a radical critique of Hogendorn's use of the vent-for-surplus model, see Freund and Shenton (1977) and Hogendorn's reply (1977).

What is the value of Myint's model in Africa in the 1980s? Whereas Myint's model highlights the potential of trade as an engine or handmaiden of growth, there are two major shortcomings in using the model for policy guidance in Africa in the 1980s. First, Myint's model fails to stress the investment in research, rehabilitation, and replanting which is needed in order to maintain a country's share of world trade in a particular commodity. Ghana and Nigeria are examples of countries which have lost world market shares of cocoa and oil palm to the Ivory Coast, Malaysia, and Brazil over the past 20 years. Second, the model assumes away the food problem and the need to invest in increasing the productivity of the food subsector. This problem is now at the crisis stage in several African countries as the frontier is exhausted and investments in irrigation,

land reclamation, and tsetse fly control are needed to intensify agriculture and increase food production.[1/]

Labor Surplus

The concept of surplus labor as outlined by W. Arthur Lewis' (1954) model of development with unlimited supplies of labor has never been seriously applied by scholars working in sub-Saharan Africa because--as Lewis acknowledged--sub-Saharan Africa is known to be a land abundant region relative to countries such as Egypt, India, Java, and Bangladesh.[2/] This abundance of land historically has been reflected in "land extensive" farming systems[3/] in which long periods of fallow (often 10 to 20 years) are interspersed with short periods of cultivation. Moreover, it was empirically shown in the 1960s that most African countries were faced with both seasonal labor surpluses during the dry season and labor shortages or bottlenecks[4/] during some periods of the farming season (e.g., weeding). As a result, Byerlee and Eicher (1974) urged model builders to concentrate on developing models of African development which were able to deal with seasonal labor shortages and surpluses, farm/rural nonfarm labor interactions, determinants of rural-urban migration, and capital and labor interactions between the agricultural, industrial sectors and international trade.

[1/] W. Arthur Lewis (1978) contends that while international trade did serve as an "engine of growth" in the 19th century this is not its proper role. He contends that technological change (especially in food production) is the engine of growth in the Third World today but acknowledges that trade can serve as a handmaiden of growth.

[2/] In an article on the proletarianization of the peasantry in Rhodesia, Arrighi (1970) criticized Lewis for viewing unlimited supplies of labor as a given rather than being produced by the colonizers or capitalists. But Lewis specifically addressed these issues by noting that in Africa the imperial powers impoverished the peasantry "by taking away the people's land or by demanding forced labor in the capitalist sector, or by imposing taxes to drive people to work for capitalist employers" (Lewis, 1954, p. 410). Still, as Hirschman points out, these practices were not central to Lewis' model of unlimited supplies of labor because "a decline in infant mortality could have the same effect in augmenting labor supply as a head tax" (1981, p. 16).

[3/] We prefer using the term "land extensive" farming system rather than land surplus models of development because even though farmers in Sierra Leone (see Spencer and Byerlee, 1976, 1977) or Tanzania (see Shapiro, 1978) have 20 to 40 hectares of land under their control they actually cultivate only a small portion of that land--3 to 5 hectares--in any one year. The small area under cultivation is a function of the shortage of family labor at critical periods in the production process and the need to keep the bulk of the land in fallow in order for the bush to regenerate and restore soil fertility.

[4/] For a discussion of seasonal labor bottlenecks, see De Wilde et al. (1970); Eicher et al. (1970); Cleave (1974); and R. A. Swanson (1981).

Land Surplus

The concept of "surplus land" has received little attention in Western development economics. While Myint's vent-for-surplus model hypothesizes that increased effective demand from international trade can stimulate the use of both surplus labor and land, there have been few attempts in sub-Saharan Africa to analyze the effects of surplus land on labor allocation and development outside the vent-for-surplus framework. Gerry Helleiner and Bent Hanson are among the few who have advanced models of development with unlimited supplies of land. Helleiner (1966b) concluded that because of the diversity of ecological zones and population densities in Nigeria it was impossible to classify Nigeria as either a land or labor surplus economy. Once it is recognized that both situations exist in a country such as Nigeria, the issue of labor mobility reemerges as an important factor in development. Bent Hanson (1979) developed a model of development with umlimited supplies of land but did not present empirical information to test his model.

The notion of surplus land has been criticized by numerous African scholars. Sunday Essang (1973) contended that aggregate statistics can be misleading because even though there are high land/man ratios (1) land in bush fallow cannot be considered surplus since under existing technology long fallow periods are needed to regenerate soil fertility; (2) aggregate statistics conceal the fact that much of the uncultivated land not in fallow is of low quality and often is not suitable for agricultural production because of unreliable rainfall; (3) the idea of land surplus ignores the point that uncultivated land often has a positive opportunity cost since it provides firewood, timber, oil palm, wild game, and forage; and (4) tsetse flies, river blindness, other diseases and health problems, and poor transport (e.g., southern Sudan) preclude the use of large blocks of land which appear as idle land in aggregate statistics. Essang further argued that development interventions based on a land surplus model can lead to (1) bias in favor of large-scale farming,[1/] (2) inadequate attention to land improvement measures, and (3) indifference to population problems.

On the basis of our review of the literature, we conclude that the concept of a land surplus economy has little heuristic value. Most economies are too large, complex, and diversified to be described as land or labor surplus. Furthermore, the notion of surplus, whether of labor or land, overlooks complex institutional and administrative questions about who controls the access to land and whether supporting services and adequate incentives are in place.

[1/] In a subsequent article, Essang (1977) points out that the oil boom in Nigeria has provided the foreign exchange earnings and government revenues for a resurgence of government-directed large-scale farming schemes--especially irrigated farming systems in northern Nigeria. Likewise, surplus land in western Sudan is cited by the government's Mechanized Farming Corporation as a justification for mechanized farming.

Assessment

As African nations entered the second decade of the postindependence period, the 1970s, the abstract theories and models of neoclassical economists were on the defensive. The assumptions of the models were recognized to be irrelevant to Africa and the resulting policy prescriptions were not taken seriously. In retrospect, the major shortcoming of Western development models was their excessive macro orientation and the inability of these models to provide a convincing specification of the agricultural sector--the sector which employs 50 to 95 percent of the total labor force in African economies. Most models ignored structural problems. Moreover, most models focused on the supply side and ignored the structure of demand and its relationship to income distribution and employment.

During the late 1960s and early 1970s, several scholars developed models based on African resource endowments and institutions in an attempt to address the weakness of imported development models. While the land-surplus model has rightly been rejected as too global, valuable theoretical frameworks have been proposed for migration (Todaro, 1969), rural small-scale industry (Liedholm and Chuta, 1976), and consumption (King and Byerlee, 1977). Byerlee and Eicher (1974) proposed a multi-sector rural economy model to examine the linkages between rural and urban firms, both large- and small-scale, and small- and large-scale agricultural producers. It is notable that the authors were proposing these models to serve as a framework for conducting empirical research rather than for deducing policy recommendations. This reflects the fact that a consensus had emerged among Western development economists by the early 1970s that because of the failure of Western development models to deal with the key problems of employment, equity, and food supply, it was necessary to go back to the basics, building an understanding of development in African rural economies based on meticulous micro-economic research.[1/]

Political Economy and Radical Perspectives

Western development economics or orthodox economics was challenged in Africa in the 1960s by the emergence and rapid growth of political economy/dependency/radical

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[1/] For example, Hayami and Ruttan (1971) noted that there was a need to step up micro research in the 1970s in order to provide the data necessary for a convincing specification of the agricultural sector. This has left Western economists open to the challenge from radical scholars that their micro studies are ahistorical, overstress technical and infrastructural constraints, and give too little attention to the influence of the world economy. For a critique of "conventional development research" and the role of Western social scientists in Africa, see Amin et al. (1978).

models of development and underdevelopment.[1/] The political economy models of development have their roots in the writings of Lenin on Imperialism and in the post-World War II writings of the late Paul Baran. Baran, a Marxist economist at Stanford University, wrote a seminal article, "On the Political Economy of Backwardness" (1952). In Baran's political economy model, he did not rule out the possibility of broad-based development in the LDCs via capitalism but he argued that in most underdeveloped countries it would be impossible to bring about broad-based development without violent changes in social and political institutions and without a dynamic industrial sector. Although Baran was clearly ahead of his time in putting his finger on institutional and structural barriers to development and the need to put the effective demand of the masses at the center of development programs, his views on agriculture were naive and misleading. For example, Baran wrote that since the marginal product of labor tends to be zero in agriculture, "there is no way of employing it usefully in agriculture." Farmers "could only be provided with opportunities for productive work only by transfer to industry." Moreover, Baran advanced an anti-small farm view when he wrote "very few improvements that would be necessary in order to increase productivity can be carried out within the narrow confines of small-peasant holdings."

Dependency Theory

One of the most influential radical views of the development process in Africa is dependency theory. The dependency interpretation of underdevelopment was first proposed in the 1950s by the Economic Commission for Latin America (ECLA), under the leadership of Raul Prebisch. The basic hypothesis of this perspective is that underdevelopment is not a stage of development but is the result of the development of the world capitalist system. Although a number of different views of dependency have been put forward by scholars such as Sunkel, Furtado, A. G. Frank (1966), Galtung (1971), and others, the following definition of dependency by Dos Santos has been widely cited:

> By dependency we mean a situation in which the economy of certain countries is conditioned by the development and expansion of another economy to which the former is subjected. (1970, p. 231)[2/]

In the 1960s, dependency theory was imported into Africa from Latin America. Over the past 15 years, Samir Amin has provided leadership in developing a Marxist

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[1/] The emergence of political economy models in the mid-1960s occurred at the same time that a number of countries (Ghana, Mali, Guinea, Tanzania) shifted from an ideology of economy policy of capitalism to an ideology of socialism.

[2/] For critiques of the dependency school of thought in Latin America, see Cardoso and Faletto (1979) and De Janvry (1982).

version of dependency theory. Amin, an Egyptian by birth, and a national accounts specialist in economics, turned his early attention to an analysis of development in Mali, Guinea, and Ghana (1965) and the Ivory Coast (1967). Amin subsequently elaborated on his dependency views through analyses of the precolonial, colonial, and postindependence periods in Africa. In Accumulation on a World Scale (1974c) and Unequal Development (1976), Amin presents an analytical framework of underdevelopment in Africa based on surplus extraction and the domination of the world capitalist system. Amin contends that social structures in the periphery are "truncated" and can only be understood in relation to the "world social structure" (1976, p. 294). One of the cornerstones of Amin's analysis is the concept of the "social formation of peripheral capitalism."[1/] Amin argues that peripheral formations are fundamentally different from those of the center because of their "extraversion."[2/] It is notable that Amin contends that "despite their different origins the peripheral formations tend to converge toward a pattern that is essentially the same" (1974c, p. 378).

Amin has provided valuable insights into the development process (1970, 1972, 1974a, 1974c, 1976), but his prescriptions for agriculture have been naive and have changed over time. For example, he attributes Africa's agrarian crisis to the predominance of agrarian capitalism which he argues takes two major forms: kulakization (class of planters who employ wage labor) and organization of export production subject to a theocratic-political authority (such as the Mourides in Senegal). While both "formations" clearly are prevalent, they by no means dominate the structure of agricultural production in sub-Saharan Africa. During the 1960s, Amin favored animal traction, promoted industrial crops, and argued that traditional social values were a serious constraint on development at the village level. He also argued that the transition to privately owned small farms was a precondition for socialism. By the mid-1970s, Amin reversed himself and recommended the collectivization of agricultural production and he abandoned his support for animal traction and industrial crops. These shifts reflect, in our view, the weakness of deriving prescriptions for agricultural policy on the basis of global and abstract analyses of the world economy. For critical surveys of Samir Amin's work, see Sheila Smith (1980) and Schiffer (1981).

[1/] Social formations are defined as "concrete, organized structures that are marked by a dominant mode of production and the articulation around this of a complex group of modes of production that are subordinated to it" (1976, p. 16). The characteristics of peripheral capitalism are concisely described in Amin (1976), pp. 333-364.

[2/] Extraversion is defined as the dominance of the exporting sector over the economic structure as a whole, which is subjected to and shaped by the requirements of the external market (1976, p. 203).

During the past decade, there have been several attempts to evaluate the contribution of dependency models in understanding the causes of poverty and underdevelopment in Africa. McGowan (1976) and Vengroff (1977) attempted to test dependency theory in Africa but came up with inconclusive results. Kleemeier (1978) criticized McGowan and Vengroff for attempting to use correlation analysis to infer causality. Palma (1978) raised several important questions about whether the dependency hypothesis can be empirically tested. Recent political economy research in Africa which focuses on agriculture include Wilcock (1978); Ntangsi (1979); Henn (1978); and some of the selections in the book edited by Heyer, Roberts, and Williams (1981). Collections of essays presenting political economy/dependency perspectives on African development include Arrighi and Saul (1968); Gutkind and Wallerstein (1976); Shaw and Heard (1979); Saul (1979); and M. A. Klein (1980). For other influential writings, see Leys (1974). For an assessment of the dependency literature in the Third World, see Tony Smith (1979).

Micro-Marxists[1/]

A small group of French Marxist anthropologists--including J. Suret-Canal, M. Godelier (1972), C. Meillassoux, G. Dupre and P. Rey (1978), and C. Coquery-Vidrovitch--and a few political scientists such as Goran Hyden have rejected the notion that a global Marxist-Leninist ideology based on a generalization of the historical experience of Europe and America is sufficient to explain patterns of development in Africa. The French Marxist anthropologists also reject the views of anthropologists such as Firth, Bohannan, Dalton, and Polanyi who stress forms of exchange rather than modes of production and the theory of reproduction (Clammer, 1975). Regarding Western economics, the Marxist anthropologists question the applicability of economic concepts derived from capitalism to economic systems with different characteristics. For example, Meillassoux (1981) argues that Western economists looking for simple economic explanations are often confused by the fact that the system of circulation of goods in pre-capitalist societies is conditioned by non-material phenomena.[2/]

The micro-Marxists attribute the roots of underdevelopment to the failure of capitalism to produce a dynamic transformation of precapitalist economies while mainstream Marxist scholars and dependency theorists stress the extraction of the surplus as the root cause of underdevelopment. Micro-Marxists argue that there is a need to

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[1/] Hirschman (1977) coined the term micro-Marxist to describe radical scholars who concern themselves with "specific events and country experiences.

[2/] See also M. Sahlin's Stone Age Economics (1974).

to understand the interaction between the precapitalist modes of production and the capitalist mode in each particular setting.[1/] As Hyden has said:

> That modes of production differ in their articulation in the Third World countries has only recently become a subject of research. How these forms of articulation affect the development potential has not yet been fully explored. (1980, p. 4)

Thus, the focus of research by the micro-Marxist has been on identifying the characteristics of precapitalist modes of production in Africa. J. Suret-Canale (1964) made a seminal contribution when he attempted to apply the famous Asian mode of production to precolonial Africa.

Meillassoux's (1964) study of the village of Gouro in the Ivory Coast is regarded by some scholars as the definitive benchmark exposition of a micro-Marxist analysis of precapitalist development and the transition from subsistence to commercial farming.[2/] Meillassoux's basic theme is that agriculture is based on communities (roughly equivalent to households) which have the goal of self-sufficiency so they are not dependent on other social classes. Circulation of foodstuffs is controlled by a social hierarchy based on seniority. He argues that these communities, "agricultural self-sustaining formations," contain within themselves all the means necessary for providing the basic social and material needs of their members but as production for external markets is grafted onto these self-sustaining formations, it is inevitable that a class society results. A collection of papers edited by Meillassoux which is based on this theme, The Development of Indigenous Trade and Markets in West Africa (1971), provides an important counter-interpretation to A. G. Hopkins' (1973) stress on the positive role of market forces in West Africa's economic history.

Catherine Coquery-Vidrovitch (1978) has also made an influential contribution in her attempt to specify an African mode of production. Unlike many other micro-Marxists, Coquery-Vidrovitch stresses the historical importance of long-distance trade in African development. A key element of her model is the exclusive ascendency of one group over external trade.

Hyden (1980) is unique among scholars working in Africa in stressing the strength of precapitalist societies in the face of the expansion of the market. Based on his extensive experience in Tanzania, Hyden argues that smallholders have rejected both colonial and postindependence interventions by the government of Tanzania because they recognize that any improvement in material conditions would come at the loss of other values.

[1/] Some of the dependency scholars share this view even though their stress is on the manner in which dependent development is conditioned by the world economy rather than on the specific articulation of precapitalist modes of production.

[2/] Terray (1972) wrote a 100-page critique of Meillassoux's Gouro village study.

Assessment

The political economy literature attempts to link rural poverty and underdevelopment to historical forces, world capitalism, and surplus extraction. Political economy scholars also emphasize the linkages between colonial policies and contemporary underdevelopment and encourage agricultural scientists to move beyond the simple view that African agriculture is unproductive primarily because of the lack of new technology. But Amin and his followers who stress global interpretations of underdevelopment in Africa have underplayed the large number of internal policies and factors which also contribute to poverty and agricultural stagnation in Africa. The Achilles heel of dependency and political economy theorists in Africa is likely to be the same one which discredited Western dual sector models in the 1960s--abstract theorizing and the neglect of empirical research at the micro level. The question remains: Can political economy and dependency scholars move beyond their abstract models to develop models based on studies of the behavior of African farmers and herders, on African institutions, and on micro/macro linkages in order to provide policy guidance in a region in which the majority of the people are farmers?

A small group of micro-Marxists, primarily French anthropologists, have rejected the view that Marxist ideology can be applied in Africa without modification. These scholars are carrying out village studies with emphasis on francophone countries in West Africa. The micro-Marxists have made important contributions to the study of the role of precapitalist modes of production in shaping the development process, the analysis of the transition to commercial farming, and the study of inequality. The ability of French Marxist anthropologists to ask what some scholars call the "key questions" about development undoubtedly explains the growing number of translations of Marxist works into English (from French and German) over the past seven or eight years.[1/] But, over the next decade, the micro-Marxists also must face the challenge of translating their insights into recommendations which can provide guidance to policy makers and donor agencies.

[1/] A collection of papers by nine French Marxist anthropologists (including Copans, Godelier, Roy, Coquery-Vidrovitch, and Meillassoux) is available in English in a paperback volume edited by David Seddon (1978). Also see Meillassoux, Maidens, Meal and Money: Capitalism and the Domestic Community (1981). See Raymond Firth (1975) for an analysis of "Social Anthropology and Marxist Views on Society."

III. FOOD AND AGRICULTURAL POLICY

As African governments tried to establish their legitimacy and chart their own courses in the postindependence period, they experimented with alternative development strategies, programs, and policies. There is now a large and growing body of literature on experiences with alternative policy instruments and development programs.[1/] While a review of the experiences cannot resolve the many policy debates facing African governments, knowledge of empirical findings on alternative programs and policies may help focus debates and identify directions for future research.

In this section, we review research on the major policy issues of the postindependence period, including (1) agrarian capitalism versus socialism, (2) agricultural planning and agricultural sector modelling, (3) large- versus small-scale farming, (4) marketing boards and food grain boards, (5) agricultural prices, (6) rural development programs, and (7) accelerated food production campaigns.

Agrarian Capitalism and Socialism

One of the most important policy issues during the postindependence period of 1960-81 has been the ideology of economic policy--capitalism or socialism. In the postindependence period beginning in the late 1950s, numerous countries shifted from capitalism to socialism after a few years of independence. For example, soon after Ghana (formerly the Gold Coast) became independent in 1957, its dynamic leader, Kwame Nkrumah, shifted from capitalism to an ideology of "African socialism." Although difficult to define, African socialism in Ghana and many other countries included the establishment of state farms, government tractor hire stations, promotion of cooperative farming and farmer associations, and a number of moves to reduce the influence of private traders.

Socialism is now an important ideology in sub-Saharan Africa even though in many countries it is socialism in name far more than practice.[2/] About one-fourth of the

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[1/] For overviews of agricultural policy issues for Nigeria, see Byerlee (1973), Wells (1974), Essang (1977), Idachaba (1980a,b, 1981), Idachaba et al. (1981), and Nigeria (1980a,b); for Zambia, see Dodge (1977) and Turok (1979); for Kenya, see Heyer et al. (1976); for Tanzania, see Green (1974), Kim, Mabele, and Schultheis (1979), and Coulson (1979); and for Sierra Leone, see Byerlee, Eicher, et al. (1982). Studies of agricultural policy in West Africa are Club du Sahel (1977), CILSS/Club du Sahel (1978a,b; 1979; 1980a,b), and Pearson, Stryker, Humphreys et al. (1981).

[2/] For example, in 1965, the Government of Kenya clearly stated its commitment to socialism (Kenya, 1965) but it has been decidedly capitalist since the 1965 pronouncement, even though fragments of state control are common. For example, in 1981, the government set the prices of cereals and the National Cereals Produce Board handled the marketing of maize (thereby excluding private traders). Moreover, parastatals such as the Kenya Tea Development Authority are common throughout the agricultural sector. But these fragments of state control do not add up to a socialist-controlled agriculture.

countries in our review are now partially or firmly committed to socialist economic ideology.[1/] The reasons for countries moving from capitalism to socialist economic ideology and back to capitalism (e.g., Ghana and Mali) and from capitalism to socialism (e.g., Tanzania, Guinea-Bissau, Mozambique, Ethiopia, and Zimbabwe) should be carefully analyzed by students of African development. We shall focus on three countries--Ghana, Mali, and Tanzania--because the experience with socialism in these countries is well documented. For the remaining countries, the literature is too fragmentary to attempt to generalize about the performance of agrarian socialism. A widely cited skeptical view of socialism is Elliot Berg's (1964) analysis of socialism in Guinea. The case for socialism is put forward by Dumont (1966, 1969); Arrighi and Saul (1968); and Seidman (1972, 1977).

When Ghana became independent in 1957, it is reported that President Nkrumah had at his disposal L150 million sterling in reserves (from its cocoa marketing board) in London banks. In 1961, Nkrumah abruptly shifted from capitalism to a radical socialist strategy which equated modernization with industrialization and the mechanization of agriculture. Ghana established highly mechanized state farms because it was thought that "small-scale private farming is an obstacle to the spread of socialist ideas" (Killick, 1978, p. 48). Ghana imported several thousand tractors, took control of cooperatives, and even established government-operated food retail shops for a brief period of time. The failure of rural socialism in Ghana in the 1960s has imposed a severe toll on its population which continues today. For an assessment of agrarian socialism in Ghana, see Miracle and Seidman (1968, 1968a); Killick (1978); and Nweke (1978b, 1979b). Also, see Nkrumah's analysis of class struggle in Africa (1970).

Mali was the second country to move to socialism soon after its dramatic break in diplomacy with France. But socialism was shortlived; the rise and sudden demise of socialism in Mali is recorded in Zolberg (1968); W. I. Jones (1972, 1976); and Martin (1976). For a pro-socialist view, see Ernst (1977).

Tanzania's abrupt shift to socialism in 1967 has induced the most voluminous literature on socialism in Africa. The vision of agrarian socialism in Tanzania is set forth in Nyerere's essay "Socialism and Rural Development" (Nyerere, 1967) and in Nyerere (1968). For a remarkably candid assessment of some of the problems in achieving rural socialism in Tanzania, see Nyerere (1977). Tanzania is now in deep financial difficulties because of drought in the mid-1970s, quantum jump in oil prices, war with Uganda, and the stagnant performance of its agricultural sector under socialism.

[1/] Benin, Guinea, Guinea-Bissau, Congo (Brazzaville), Ethiopia, Tanzania, Zimbabwe, Mozambique, Angola, Mauritius, Equatorial Guinea.

Although a number of observers dismiss Tanzania's experiment with its Ujamaa and villagization programs as failures, there have been important gains in literacy and social services. For example, Tanzania's life expectancy at birth increased from 42 to 52, an increase of 25 percent over the 1960-79 period. The adult literacy rate increased from 10 to 66 percent over the 1960-76 period (World Bank, 1981b, p. 181). These are dramatic achievements which are often overlooked when facile terms such as success or failure are used in place of detailed evaluations. Valuable insights on socialism in Tanzania are found in Hyden's recent book (1980), a collection of essays by Mwansasu and Pratt (1979), Barker (1979), and Samhoff (1981). For a recent bibliography on Ujamaa villages, see McHenry (1981). For a comparative study of four small socialist states, including Tanzania, see Morawetz (1980).

There are many unanswered questions about Tanzania's experiment with agrarian socialism. A central question is why was coercion used by President Nyerere to round up farmers and move them into villages? Many pro-Tanzania scholars avoid this topic. Second, how serious were exogenous factors such as the drought and war with Uganda in undermining socialist programs at critical junctures over the past 5-7 years? Third, were faulty economic policies the Achilles heel of socialism in Tanzania? Nyerere (1967) pointed out long ago that the worst enemy of socialism is faulty economic policies. Clearly, agrarian socialism is on the defensive in Tanzania and the Revolutionary Party has taken a number of steps in 1981 to move to increase incentives to farmers, including more emphasis on private plots. Even early and strong admirers of President Nyerere, such as Rene Dumont, recently wrote "Nyerere, through all his writings has made all Europe dream but the stark reality dispels all illusion" (Dumont and Mottin, 1980).

It is too early to pass judgment on the performance of agrarian socialism in Africa, particularly because of the widely different definitions of socialism and the absence of data on countries such as Benin and Mozambique. Moreover, as Gerry Helleiner pointed out in his perceptive article on "Socialism and Economic Development" (1972), all countries--capitalist or socialist--must break common economic constraints, including capital formation, foreign exchange, human resources, and institutional and technical bottlenecks. We would add that governments following either economic ideology must develop agricultural institutions and incentive structures to solve the most basic prerequisite of development--achieving a reliable food surplus. Capitalism or socialism by itself cannot solve food and poverty problems. There are many capitalist and socialist countries in Africa that are in an economic morass and policy assessments should be based on the effectiveness of specific programs in dealing with key constraints rather than facile statements about socialism as an ideology of development. For an uneven but valuable

assessment of socialism in the Third World, see the volume edited by Desfosses and Levesque (1975). For a recent reassessment of socialism in sub-Saharan Africa, see the volume edited by Rosberg and Callaghy (1979).

References on agrarian socialism are as follows:

General: Desfosses and Levesque (1975); W. A. Lewis (1978a); Morawetz (1980).

Africa: Berg (1964); Friedland and Rosberg (1964); Arrighi and Saul (1968, 1973); Rosberg and Callaghy (1970).

Ghana: Amin (1965); Miracle and Seidman (1968a, 1968b); Killick (1978).

Guinea: Amin (1965).

Guinea-Bissau: Goulet (1978); Urdang (1980).

Mali: Amin (1965); Zolberg (1967); Ernst (1977); W. I. Jones (1972, 1976); Martin (1976).

Mozambique: Isaacman (1979); Saul (1979).

Tanzania: Nyerere (1967, 1968); Dumont (1969); Feldman (1969); Helleiner (1972); Van Hekken and Van Velzen (1972); Mwansasu and Pratt (1973); Lofchie (1976); Saul (1977); Barker (1979); Coulson (1979); McHenry (1979, 1981); Von Freyhold (1979); Due (1980); Dumont and Mottin (1980); Hyden (1980); F. Ellis (1980); Samoff (1981); Zalla (1981).

Planning and Agricultural Sector Modelling

Planning was launched in the colonial period immediately following World War II. For example, in 1946, Nigeria prepared a ten-year plan in response to colonial office requirements. As countries became independent, in the late fifties and early sixties, almost all countries launched medium-term plans which focused on high rates of growth of GNP as the target and indicator of development and relied heavily on foreign aid.[1/] For example, the government of Mali pointed with pride that the 11 percent growth target in its first Plan was the highest in any African development plan in the sixties (Zolberg, 1967). But Mali scaled down its target growth rate soon after the implementation of its Plan was underway and a few years later dropped its plan following a coup. Gusten (1967) expressed the obsession of economists over growth rates and macro planning in the 1960s in his "Can the Nigerian Economy Grow at 6 Percent per Annum in the Near Future--A Pre-Planning Exercise?" at a time when the civil war was underway in Nigeria.

Most assessments of planning over the 1960-80 period conclude that failures have far outweighed achievements. Professor Aboyade, a distinguished Nigerian economist and

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[1/] The volume edited by Helleiner (1968b) is a standard reference on agricultural planning in East Africa during the sixties. For an analysis of Kenya's agricultural planning since independence, see Heyer, Maitha, and Senga (1976); Leys (1974); and Holtham and Hazlewood (1976). For appraisals of planning in East Africa, see Widstrand (1976) and Apthorpe (1976).

architect of Nigeria's Second Five-Year Plan, concluded, "For most of tropical Africa planning over the past two decades has been little more than false hope" (1973). Rimmer, an economist at the University of Birmingham with considerable experience in Ghana, noted, "any resemblance between development plans and the actual course of economic change in African and other poor nations is purely coincidental" (1969). Shen (1974) reviewed development plans and national income data for 22 tropical African countries in the late 1960s and pointed out there were major problems in implementing plans due to the unstable political climates and weak institutions for plan implementation. In a survey of planning in developing countries, Killick (1976b) concludes that planning has not lived up to its expectations. But Helleiner (1972a) wisely points out that one should not equate the preparation of plans with economic planning. Although many elaborate national plans were prepared by foreign experts in the 1960s, most were dropped or ignored soon after they were published. Helleiner correctly points out that most African countries have made substantial improvements over the past 20 years in the quality of decision making, the evaluation of economic alternatives, and in the implementation of projects. These achievements are easy to overlook in critiques which focus on whether countries achieved the growth rates spelled out in the plans rather than examining the slow process of improving the data base, training people and strengthening institutions.

Turning to agriculture, major agricultural sector assessments were carried out in Nigeria, the Ivory Coast, Sierra Leone, Ghana, Zambia, and the Sahel over the past twenty years. For a model of Senegal's agricultural sector, see Labonne and Legagneux (1977). World Bank-sponsored modelling efforts have been completed by Goreux (1977) in the Ivory Coast and by Blitzer (1979) in Zambia. Nigeria has been heavily studied.[1/] A four-year Nigerian agricultural sector analysis was carried out in the late 1960s by the Consortium for the Study of Nigerian Rural Development under the leadership of Glenn L. Johnson. Johnson and his team analyzed three alternative policy packages over the 1969-85 period and concluded that Nigeria should give urgent attention to food crop research, eliminate all export duties and taxes on agricultural products, and shift the fiscal burden from agriculture to petroleum in order to provide incentives to harness the energy of its six million small farmers. Thirty-two working papers and a final report by G. L. Johnson et al. (1969) were published by the Consortium. Building on these findings, Johnson, Manetsch, and colleagues developed a generalized simulation approach to

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[1/] Nigeria's planning experience has been well documented. Stolper's influential book Planning Without Facts (1969) stressed the lack of data in preparing Nigeria's first Five-Year Plan in the early 1960s. Other analyses of Nigeria's planning processes during the 1960s can be found in Aboyade (1973), Dean (1972), Kilby (1969), Gusten (1967), Wells (1974), Eicher and Liedholm (1970), and Eicher and Johnson (1970).

agricultural sector analysis in Nigeria (see Manetsch et al., 1971). Byerlee (1973) later developed a simulation approach to trace the indirect employment and income distribution effects of alternative agricultural development strategies in Nigeria. Byerlee's ten-sector dynamic macro model was linked to an employment-incomes model and to the agricultural sector model developed by Manetsch et al. (1971).

A number of major agricultural sector modelling efforts have been aborted and never published. For example, a foreign consulting firm completed a one million dollar agricultural sector assessment in Ghana in 1969 but the work was regarded by Ghanians as superficial and merely a reassembly of secondary data. The draft papers were never formally published. Also, the Massachusetts Institute of Technology's simulation study of the Sahelian region in West Africa offers some insights into the pitfalls of "crash" studies. The drought in the Sahelian region over the 1968-72 period brought forth massive food grain shipments and a concern by donors for generating information on how to aid in the recovery and long-term development of the region. But the micro data base in the Sahel was weak and spotty when the crash one-year research program was launched by MIT's Center of Policy Alternatives. The MIT researchers relied on secondary data and used a systems dynamic simulation approach to trace long-term development strategies for the Sahelian region over the 1975-90 period. The participation of African governments and African researchers in the MIT study was modest. The MIT project was discontinued in 1974 and preliminary results were published in a ten-volume study (see Seifert and Kamrany, 1974).

Over the past 10-15 years, the modest performance of these major modelling efforts can be traced to the static nature of the models, and the lack of micro data and African participation in the conduct of the studies. As a result, many of the modelling efforts were dropped after the departure of the foreign researchers. The shortcomings of these major modelling efforts have led many donors to shift their support to more limited (3-4 months) agricultural sectoral assessments. Although it is easy to criticize these quick and dirty assessments, they represent a "half-way house" between major 2-4 year modelling efforts and the ad hocism of the project-by-project approach to planning. Nevertheless, there is an obvious need to increase funding for macro studies of river basins, livestock and cropping interrelationships, and food and nutrition policies. For example, in the Sudan, Somalia, and the northwestern region of Kenya, there is a need to develop models of the interrelationships between livestock, food crops, human resources, and rural institutions over an entire region, country, or group of countries. But in most countries until more Africans are trained, agricultural sector models which cost millions of dollars and depend on foreign researchers will likely be perceived by Africans as "academic toys" rather than productive tools which can help Africans improve planning and decision making.

Large Versus Small Farms

A continuing debate in agricultural policy has been the economics of assisting smallholders versus promoting large farms, including plantations, state farms, land settlements, and river basin settlements. In the 1960s, the debate over large- vs. small-scale agriculture became known (especially in Eastern Africa) as the transformation versus the improvement approaches. The transformation approach featured a wide variety of large-scale farming (plantations, settlements, and state farms) and processing plants; it was designed to bypass the lengthy process of improving small farms within the existing village structure. The major ingredients of the transformation strategy were infusion of capital-intensive technologies, such as tractor mechanization, central management (often European), and mobilization and training of an unskilled labor force by removing people from their villages.

Smallholder Farming: A Descriptive Overview

Smallholder crop cultivation is the predominant farming system in sub-Saharan Africa. Smallholder farming is primarily characterized by reliance on family labor, a small stock of physical capital, and abundant land relative to Asian countries.[1/] Family labor is the most important factor of production, with family labor inputs ranging from 80 to 90 percent of total labor inputs (Byerlee, 1980). Farming households generally have 6 to 10 family members and it is common for households to include more than one nuclear family. Adult male farmers work an average of 5 hours per day or 1,000 to 1,500 hours per year in farming activities but the number of hours of labor devoted to off-farm activities, such as rural small-scale industries, is substantial. This is in stark contrast to Egypt and many Asian countries where total hours worked by adults in farming range from 2,500 to 3,000 hours per year (Cleave, 1974). Women play an important role in farming, processing, and marketing but the extent of their participation varies greatly by activity, ethnic group, and religion. Children are an important source of labor for tasks such as weeding, the collection of firewood, bird scaring, carrying water, and taking care of sheep, goats, and cattle.

Most small farmers till their land with human labor and hand tools, including metal hoes, cutlass or machete, digging sticks, and knives. Although the shift from hand cultivation to animal traction cultivation (oxen and donkeys) has been promoted for more than 50 years, animal traction is still a minor source of farm power in almost all countries in sub-Saharan Africa. Capital investments in housing, storage, and perennial crops are

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[1/] For example, small farmers in the Semi-Arid Tropics (SAT) zone of West Africa have three times as much land at their disposal as farmers in the SAT zone in southern India.

mainly created by family labor using local materials. Although the separation of farming and livestock production is common throughout sub-Saharan Africa, there is a slow but discernible adoption of livestock enterprises by sedentary farmers.

Cash expenses generally represent a small proportion of the value of production. Purchased inputs--seed, fertilizer, and chemical pesticides--are not widely used by farmers. Most fertilizer is applied in the form of organic manure.

The land area controlled[1/] by a typical smallholder varies considerably but it is generally far larger than in Asia. For example, in a study of smallholder cotton production in northwestern Tanzania, K. Shapiro (1978) reports that the typical survey farm controlled about 25 acres of land of which 4 were in cotton, 5.5 in food crops, and the remainder in fallow and grazing land. Likewise, Spencer and Byerlee (1976) report that the typical smallholder in Sierra Leone controlled about 40 acres of land but actually farmed only a small portion of the 40 acres. The idle land was regaining its fertility in the bush fallow system.

The area cultivated per family has consistently been found to range from 2 to 10 acres throughout sub-Saharan Africa (de Wilde et al., 1967; Upton, 1973; Cleave, 1974; Winch, 1976; Spencer and Byerlee, 1976; and Heyer and Waweru, 1976). Because of the widespread reliance on hand tools and the lack of a landless labor class, the area cultivated per farm family critically depends on the size and composition of the family labor force.

While crop production is the major activity of smallholders, off-farm activities such as trading, small-scale industry, livestock, and fishing are important activities throughout sub-Saharan Africa. Micro-economic research has shown that farmers devote a significant amount of their time to off-farm activities (Luning, 1967; Liedholm and Chuta, 1976) and that there is an inverse seasonality with a large percentage of the total hours being worked off-farm during the dry season(s). Although small farmers strive to meet their own food needs, 20-40 percent of staple food production is marketed in most countries.[2/]

[1/] Even though a farmer does not "own land" in the sense of having freehold title to land, farmers in most countries have "control" or use rights to land for their lifetime; these use rights can be passed on to heirs.

[2/] For example, from 30 to 40 percent of small farm production was sold in Kenya (Heyer and Waweru, 1976), 48 percent in Sierra Leone (Byerlee et al., 1977), and 24 percent of the total value of farm production in northern Nigeria (Norman, Pryor, and Gibbs, 1979).

Large-Scale Farming: An Overview

Large-scale farming in sub-Saharan Africa dates to the colonial period with the introduction of plantations and large European farms which produced for export markets. Today, large-scale farming accounts for a substantial portion of export crop production in only a few countries in sub-Saharan Africa.

In the 1960s, Western advisors generally endorsed large farms and plantations because it was assumed that they would benefit from economies of scale, that they would be convenient vehicles for newly independent governments to "bring rapid development" to selected rural areas, and that they would provide rural employment for the growing number of school leavers.[1/] The rationale of the transformation approach is reflected in the recommendation by the International Bank Mission to Tanganyika (later Tanzania) that the Government of Tanzania should support land settlement schemes because "quicker progress towards these ends is likely to be made, within the limitations of the resources available for government action, by planned settlement of empty areas than through exclusive concentration on improvement of methods (small farms) in settled areas" (IBRD, 1961, p. 131).[2/] Success stories of large-scale agriculture from the colonial period such as the world famous Gezira scheme in the Sudan (Gaitskell, 1959),[3/] tea plantations in East Africa, Firestone rubber estates in Liberia, and Unilever estates in the Belgian Gongo (now Zaire) were often cited in the 1960s as examples of the superiority of large-scale agriculture. But proponents of large schemes often overlooked or glossed over the horrendous failures of large-scale schemes such as the East African groundnut scheme introduced by the British colonial service in Tanganyika after World War II, the failure of Mokwa settlement scheme in northern Nigeria in the 1950s (K. D. S. Baldwin, 1957), and the mixed results with land settlement schemes and state farms in Africa

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[1/] A term widely used to describe recent graduates of primary and secondary schools who are trying to enter the labor force.

[2/] The Government of Tanganyika followed the advice of World Bank experts and started 23 settlement schemes over the 1963-67 period which featured heavy capital investment, government management, and little participation by the settlers (Ingle, 1972). But the 23 schemes met with little success and in 1967 Tanzania dropped the transformation approach and shifted to a rural socialist strategy which focused on helping small farmers through the Ujamaa program and later the village development scheme (Nyerere, 1967).

[3/] For a critical appraisal of the Gezira scheme from a radical perspective, see Barnett (1977).

(Chambers, 1969) and throughout the world (W. A. Lewis, 1964; FAO, 1976; Higgs, 1978).[1/]

State farms were another type of farm organization included in the transformation strategy of agricultural development in the 1960s. State farms were adopted by the Governments of Sierra Leone and Ghana in the late fifties and early sixties. Sierra Leone established state farms to produce export crops in each of 12 regional provinces but the farms were abandoned within a few years. In Ghana, state farms and tractor mechanization were the centerpieces of Nkrumah's socialist strategy of development (Miracle and Seidman, 1968a). Ghana's dismal record of tractor mechanization and state farms was documented by Kline et al. (1969), Nweke (1978a,b), and Killick (1978).

Plantations were another type of large-scale farming pursued by African leaders in the 1960s. Since it is almost impossible to gain access to data on private and government plantations, it is difficult to pass judgment on the economic, social, and political costs, and returns on plantations. Studies by Saylor and Eicher (1970) and Essang and Ogunfowora (1975) of plantations in Nigeria are examples of the limited research on the economics of plantations. Since British colonial land policy prevented plantation development in Nigeria, plantations were insignificant until the constitutional change of 1951 permitted the establishment of plantations by both private and foreign capital. Saylor and Eicher (1970) found that government plantations in Nigeria were generally unprofitable because lack of technical data, poor management, and high turnover in unskilled labor (frequently 100 percent per year), etc. The number of private plantations increased during the 1951-65 period in Nigeria but marketing board taxes on oil palm and rubber reduced the rate of return on plantations to almost zero by the early 1960s (G. L. Johnson, 1968).

Small-Scale and Large-Scale Farming in Nigeria

Since both the transformation (large-scale) and improvement (small-scale) strategies were pursued in different regions of Nigeria in the 1960s, Nigeria provides a unique case study of the results of these two alternative strategies. During Nigeria's first Development Plan (1962-68), the three regions in the southern part of the country (Western, mid-Western, and Eastern) devoted some 70 percent of their capital and recurrent budgets in

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[1/] We should not give the impression that all settlement schemes in Africa are large-scale and all settlement schemes are failures. Numerous examples of settlement schemes for smallholders are found in Eastern Africa, including the famous one million acre settlement scheme in Kenya which was conceived by R. Swynnerton and launched in 1953 to transfer land from large white farmers to small Kenyan farmers (Kenya, 1954). For an appraisal of Kenya's settlement schemes, see MacArthur (1975) and Clayton (1978). For a discussion of spontaneous settlements in Kenya, see Mbithi and Barnes (1975); in Senegal, Rocheteau (1975); and in the Sahelian countries of West Africa, see CILSS/Club du Sahel (1978b).

agriculture to the transformation approach (farm settlements, school leaver farms, and plantations). On the other hand, the Northern region pursued an improvement strategy during the 1962-68 Plan to help small farms through subsidized fertilizer, credit, and farmer training centers. The political urgency of "getting on with development" and "bringing development to the people" explain why the three southern regions in Nigeria opted for crash schemes. As Nigeria approached independence in the late fifties, political leaders in the three regions in the southern part of the country were not in a mood to wait for research results on whether to pursue large-scale or small-scale agricultural development strategies. For example, in 1959--one year before independence--a policy paper issued by the government of the Western Region noted that "while scholars conduct unbiased research . . . agricultural development must go on" (Nigeria, 1959, p. 9). The policy paper noted that political leaders from western Nigeria had visited the Gezira scheme in the Sudan and Moshav settlements in Israel and concluded that experience in other countries has shown that ". . . a system of co-operative farm settlements would be a major step in the agricultural development of the Region" (Ibid).

In a detailed analysis of the western Nigeria's settlement scheme, Roider (1971) found that after six years of operation, the government had spent $11,200 per settler, or double the amount originally projected, while yields ranged from 25 percent (cotton) to 65 percent (rice) of the yields estimated in the feasibility study. Similar settlement schemes were tried in the other two regions (Eastern and mid-Western) but by the end of the 1960s it was obvious that the settlement schemes had failed in all three regions in southern Nigeria (Andreou, 1981). The reasons for the failure of schemes in southern Nigeria were almost identical to the findings of W. Arthur Lewis (1964) in his review of settlement schemes and Nelson's (1973) study of 23 schemes in Latin America: lack of technical and microeconomic data, superficial planning, overinvestment in housing and social services, inappropriate mechanical technology, and lack of participation by settlers.

Eicher and Johnson (1970) evaluated the consequences of pursuing transformation versus the improvement strategies and concluded that smallholder improvement programs rather than land settlements or plantations should form the backbone of Nigeria's agricultural strategy over the 1969-85 period. These findings were reinforced by Wells' authoritative book (1974) on agricultural policy and plan implementation during Nigeria's First Plan (1962-68).

Assessment

Small-scale farming has many advantages relative to large-scale farming in Africa. Although few donors support large-scale farms and ranches today, there is still substantial support among African politicians and policy makers for large-scale agriculture. For

example, large-scale projects are still of central importance in Nigeria and in Ghana. Moreover, foreign private investors have launched large-scale food production schemes in several countries. But these large-scale schemes are experiencing unforeseen technical and economic problems. For example, Uni-Royal's large-scale food production complex in Liberia was terminated in the late 1960s. A $2.1 million foreign-financed maize farm and grain storage complex in central Ghana also experienced numerous difficulties and it is now operated as a state farm. Several observers have reported that large-scale wheat schemes have failed in Tanzania.[1/] In the Cameroon in 1979, we have unofficial reports that a 4,000-hectare government wheat mechanized scheme with 35 tractors did not produce enough--22 kilos of wheat per hectare in 1979--to recover its seeding rate of 100 kilos per hectare.

Although it is understandable why governments do not publicize the failures of many large-scale farming schemes, we have gleaned enough information to conclude that in most countries, large-scale/capital-intensive food production complexes cannot compete with African smallholders for meeting staple food needs in the 1980s.[2/] To be sure, there is a limited scope for a few multi-national firms to produce fresh fruit and cut flowers for European markets (FAO, 1976d). For example, string beans are flown from Upper Volta to Europe during the winter season. A multi-national firm producing strawberries and other fruit in Senegal for European markets went bankrupt in 1980. Delmonte has a 10,000 hectare pineapple plantation in Kenya. But there is very little empirical research on these multi-national firms. The controversy surrounding multi-national firms is discussed by Widstrand (1975) and Sklar (1976).

Most large-scale farming and land settlement schemes in Africa have been failures over the past 50 years. But settlement is still an important topic being debated because according to FAO estimates, two-thirds of the remaining arable land in the world is in sub-Saharan Africa. The challenge is to learn from past settlement schemes. Research has shown that the role of the government should shift from planner, financer, and manager to providing agronomic research, disease control, and a minimum of infrastructure. Government policy should help African families build their own houses and clear their own land in order to drive down the capital cost per settler.

[1/] But several reviewers pointed out that it is premature to write off wheat in Tanzania. The economics of wheat production is an empirical question which should be addressed by researchers in East Africa.

[2/] Research and empirical findings on the economics of smallholder farming are reviewed in Part IV.

Marketing Boards and Food Grain Boards

The control of the agricultural surplus is a common denominator of both the colonial and postindependence periods. Various taxes (head taxes, hut taxes) and compulsory planting of selected export crops were imposed by colonial authorities to stimulate the production of export crops and to capture the agricultural surplus. Shortly after World War II, the British colonial governments introduced marketing boards in their East and West African colonies following the relatively successful record of marketing boards in Australia and New Zealand since the 1930s. The objective of the marketing boards was to stabilize producer prices and foreign exchange earnings and to reduce interseasonal price movements.

In the 1960s and 1970s, numerous African governments introduced grain boards to control producer prices of food grains and to channel food to the urban centers.[1/] Boards usually accumulate and carry stocks to mitigate both intra-annual and inter-annual fluctuations in price and supply and develop distribution systems to facilitate the transfer of grain from surplus to deficit regions.

Marketing Boards

The introduction of marketing boards was followed by a wave of studies by economists. Leading the charge against the marketing boards was Peter Bauer who contended in his West African Trade (1954) that marketing boards failed to stabilize producer prices and reduce seasonal price variations, and that the boards dampened producer incentives by paying producers one-half to two-thirds of world prices of exports such as cocoa, oil palm, coffee, and rubber. Later, A. G. Hopkins (1973) showed that export producers in the Gold Coast (Ghana) lost 41 percent and Nigerian producers lost 27 percent of their potential gross income through marketing board taxes over the 1947-61 period.

Helleiner's meticulous study "The Fiscal Role of the Marketing Boards in Nigeria" (1964) introduced new criteria for examining the performance of the boards. Instead of being preoccupied with the issues of whether marketing boards stabilized producer prices, producer incomes, and foreign exchange earnings, Helleiner contended that the more important issue is whether the boards are effective in performing the fiscal role of capturing the agricultural surplus for the development of both urban and rural areas. Helleiner was of the opinion that no single taxing scheme could simultaneously achieve multiple goals of stabilizing producer prices, foreign exchange earnings, and interseasonal

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[1/] While it is common to refer to these boards as government boards, most food grain boards have a quasi-commercial character and some degree of autonomy from the government.

price variations. Helleiner concluded that, on balance, marketing boards were the best mechanism for mobilizing the agricultural surplus in subsistence economies like Nigeria in the 1950s and 1960s because of the lack of administrative capacity to impose other taxes such as land and income taxes and the lack of other sources of revenue such as petroleum, gold, phosphate, and timber. But Helleiner's qualified endorsement of marketing boards was based on a shaky micro data base; he was unable to show that the rates of return on government investments (financed by marketing board surpluses) in plantations, hotels, airlines, and industrial estates were unambiguously higher than if Nigerian farmers had received higher prices for their export crops and had reinvested their expanded earnings in farming (e.g., such as the new hybrid oil palms) or if the boards had indirectly returned the surplus to farmers through fertilizer subsidies and agricultural research. Idachaba (1973) concluded that marketing boards in Nigeria substantially dampened producer incentives and restricted output and employment generation in agriculture. Olayide, Ogunfowora, and Essang (1974) found widespread inefficiencies in Nigerian marketing boards and recommended alternative structures such as producer and marketing cooperatives. For other research on marketing boards, see Storm (1976) for Senegal; for Tanzania, see Kriesel et al. (1970); in Ghana, see Kotey, Okali, and Rourke (1974); and in West Africa, see Blandford (1979).

During the past 30 years, taxes on export crops via marketing boards have provided a convenient way in many countries to capture and transfer the agricultural surplus to finance government airlines, hotels, factories, plantations, and in a few cases subsidized inputs such as fertilizer for farmers. Whether export taxes and marketing boards should have been scrapped or continued over the past 30 years needs to be analyzed on a country-by-country basis. The central questions have been the level of taxes imposed by the boards, the use of the agricultural surpluses, and whether there were fiscal alternatives to the boards. Clearly, countries such as Nigeria, Ghana, and Tanzania had few fiscal alternatives to marketing boards in the 1950s and 1960s because they lacked the administrative capacity to register land and collect land taxes and they lacked mineral and petroleum exports. Marketing boards--like import substitution in Latin America in the 1950s--served a useful role at a particular stage of economic history of some African countries. A few countries, such as Nigeria, have been able to find alternative sources of revenue in the seventies and have been able to reduce the tax burden on export crops. But the problem of raising government revenues in agrarian economies without mineral or petroleum exports remains a central issue in the 1980s.

Food Grain Boards

Several African governments have given food grain boards monopoly power over domestic distribution of food grains, making private trade in grains illegal. An important argument in favor of governmental monopolies in food grain trade is that it allows governments to subsidize trade in remote, less productive areas. It is often stated that boards need to be able to control the distribution of 20 to 25 percent of total grain production to affect prices (Becker, 1974; Sorenson et al., 1975; Groleau and Kohler, 1979) but it is common for private, and often illegal, trade in food grains to handle 85 percent or more of the marketed surplus in countries with grain boards. As a result, even where grain boards have been made legal monopolists, monopoly power is often more legal fiction than fact (Lele and Candler, 1981). The inability of grain boards to dominate the flow of grain makes it almost impossible for them to stabilize prices and to transfer grain from surplus to deficit regions.

Many researchers have argued that the same issues plague food grain boards as export marketing boards faced in the '50s and '60s: inefficiency, dampened producer incentives, corruption, and a cadre of thousands of employees who are idling away their time.[1/] There is substantial evidence that administrative and operating costs of most grain boards are quite high, reflecting inefficient operations (Sorenson et al.; Temu, 1975; Wilcock, 1978; CILSS/Club du Sahel, 1977; Grolleaud and Kohler, 1979; Blandford, 1979; Lele and Candler, 1981). While some boards have managed to reduce per unit costs over the years (e.g., The Gambia Produce Marketing Board in Gambia; Blandford), the operating costs of most have escalated mainly because of high overhead, thousands of employees, and fleets of trucks. The marketing margins of grain boards have tended to be high, clearly above those of private traders for comparable services (Berg, 1975). Large margins effectively mean that a large percentage of the total sales value accrues to government boards rather than producers.[2/] This factor is particularly important since high margins necessitate payment of low farm gate prices if retail prices are to remain at a politically acceptable level.

Peter Temu showed that not only have mark-ups by grain boards in Tanzania been high relative to private traders, they have been extremely variable, largely because of the

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[1/] When Senegal abolished its grain board--ONCAD--in late 1980, it eliminated about 4,500 employees. Likewise, Mali's grain board--OPAM--is reported to have between 6,000 and 8,000 employees on its payroll.

[2/] The World Bank (1981b, p. 59) reports, for example, that charges for marketing, storage, and transportation in Kenya accounted for 34 percent of the f.o.b. border price for maize, 23 percent for wheat, and 48 percent for rice during 1972-79. These figures are typical of government grain board margins in other countries.

inability of boards to control their costs. Many governments have adopted a dual policy of setting guaranteed producer prices in order to reduce the uncertainty faced by farmers and controlling consumer prices of key staple foods. The margins available to boards are a residual of the two controlled prices and frequently do not cover costs in any given year (CILSS/Club du Sahel, 1977a, 1979).

Several researchers have found that improvements in operational efficiency should enable most grain boards to carry out their duties with smaller margins. Sorenson et al. and Temu show, for example, that administrative costs are a large component of the margins received by grain boards. Several researchers have argued that extensive duplication of functions among grain boards underlies some of these costs (Kriesel et al., 1970). There are widely acknowledged problems of losses of grain during storage and transportation. Supplementary urban grain storage with a network of rural storage centers may reduce transport costs by eliminating the transfer of grain from rural areas to capital cities at harvest and the redeployment of the grain both to rural areas in times of crisis. Some grain boards are not taking advantage of opportunities to offset their costs by generating revenues through spatial price arbitrage. Thodey (1969) shows, for example, that price differences in Ethiopia exceeded transportation costs over half of the time on routes between markets connected with Addis Ababa.

There is now growing evidence that grain boards are often a constraint on the production and marketing of food. Wilcock (1978), for example, argued that the activities of grain boards in the Sahel have contributed to the misallocation of resources because of overcentralization, high operating costs, duplication of effort, and dysfunctional incentive systems. Heyer and Waweru (1976) reported that the high degree of regulation and control of food marketing has resulted in low producer prices and high consumer costs in Kenya. The government of Senegal's decision to abolish its grain board--ONCAD--in late 1980 is a rare example of a country admitting that its board was ineffective. Berg (1975, 1979) has argued that the absence of a suitable substitute for the private trader in primary markets is a major constraint on food self-sufficiency in the Sahel. While most researchers have argued for minimizing the role of governments in food grain trade, Berg contends that even mixed (government/private) marketing arrangements are unworkable. Berg rejects what he calls the "imprudent peasant/monopolized market" model which he feels dominates the views of African planners, offering as an alternative a "prudent peasant/competitive market" model. Of three potential alternatives governments might consider, including continuation of the status quo, increased public control, and competitive liberalization, Berg firmly believes only competitive liberalization will work to the benefit of both producers and consumers.

One of the primary results of creating legal monopolies for food grain boards has been widespread illegal marketing which involves a volume often several-fold that of legal marketings (Collins, 1976). Temu argued that the failure of grain boards to control domestic food grain distribution systems even in countries where they are given legal monopoly power can largely be traced to the disincentive effect of low and uncertain producer prices offered by grain boards. Temu examined three basic approaches to minimizing illegal marketing in Tanzania: (1) change the legal price so it better reflects supply and demand conditions, (2) withhold and release stocks to counteract extreme price fluctuations, and (3) improve enforcement of statutory prohibitions. After examining the economic costs of the alternative approaches, Temu rejected the statutory approach as unfeasible. He concluded that grain boards would be more effective if they reduce the scope of their activities to a few specific functions, allowing a greater play of market forces in Tanzania's economy.

Agricultural Prices

The manipulation of agricultural prices is a standard government technique to influence the level and composition of agricultural production and the transfer of the surplus to urban areas. The primary mechanism is to set prices of major agricultural commodities and agricultural inputs administratively and to enforce the administered prices through the buying and selling operations of parastatals and licensed buying agents. African governments also influence relative agricultural prices through indirect pricing policies, including export taxes, subsidized credit and fertilizer,[1/] and overvalued exchange rates. The major reasons for intervening in agricultural pricing have been to (1) stabilize prices and production, (2) foster self-sufficiency, (3) generate tax revenue, (4) curb the profit of middlemen, and (5) control the cost of living for urban consumers.

There have been few studies of the aggregate impact of pricing policies. Helleiner's (1964, 1966a) studies of the fiscal role of marketing boards in Nigeria and his (1968a) review of pricing strategies in Tanzania are among the exceptions. Helleiner argues that the key in analyzing pricing policies is to ensure that the structure of price and tax incentives--not the level--is working in the right direction. Helleiner concluded that "clearly, the income distribution policy implicit in Tanzania's wage and agricultural pricing policies has worked to the increasing disadvantage of the smallholder agricultural sector" (1968a). Olayide, Ogunfowora, and Essang (1974) used systems simulation to test the effects of marketing board pricing policies on the Nigerian economy; the authors

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[1/] For example, the government subsidizes 80 percent of the fertilizer prices paid by farmers in northern Nigeria in 1981 (World Bank, 1981b).

concluded that depressed producer prices had reduced the growth of the economy and they recommended the elimination of licensed buying agents and centralized fixing of prices. On the question of input subsidies in Nigeria, see Idachaba's pioneering articles (1973, 1977).

During the 1970s, numerous researchers documented how agriculture has been adversely afffected by the impact of pricing policies designed to promote domestic industry. For example, the ILO report on the Sudan found that the net incidence of taxes and subsidies discriminated against agriculture in favor of industry and commerce (ILO, 1976). Reviewing policies in Kenya, Heyer, Maitha, and Senga (1976) report that despite policy statements to the contrary, government programs are still heavily in favor of urban and nonagricultural activities and that there was a large and growing net resource flow out of the agricultural sector throughout the 1960s and 1970s. Evidence that pricing and marketing policies followed by the Zambian government have had an adverse effect on the rural-urban income gap and on self-sufficiency in food is presented in Doris Dodge's (1977) study of agricultural policy in Zambia and in Maimbo and Fry's (1971) study of the terms of trade between agriculture and the nonagricultural sector. For further references on the impact of pricing policies in Zambia, see Kinsey (1978), Daniel (1979), and Turok (1979).

Byerlee, et al.'s (1982) analysis of employment-output conflicts and factor price distortions in Sierra Leone reveals that (1) there is a wide choice of technology available not only between large-scale and small-scale sectors, but within each sector; (2) the choice of technology was found to be sensitive to relative factor prices; (3) administratively established prices, wages, taxes, and subsidies have favored the adoption of larger-scale, capital-intensive techniques in agricultural production, processing, fishing, and industry; and (4) that a continuation of present government policies will have a serious adverse effect on rural employment and national income.

The World Bank report (1981b) presents substantial support for the view that pricing policies are a root cause of the food and agricultural crisis in Africa. In one example, the authors argue that severe cutbacks in production in Tanzania and Ghana resulting from low official prices have dissipated their export positions. In 1980, Tanzania's total exports of major agricultural commodities (which account for nearly two-thirds of the total value of all exports) were 28 percent lower than in 1966 and export earnings fell from 25 percent of the GDP in 1966 to 11 percent in 1979. Ghana has long been the world's leading cocoa exporter but Ghana's cocoa production declined from a peak of 566,000 metric tons in 1965 to 249,000 tons in 1979 and Ghana's position in world trade of cocoa

fell to third in 1979, behind the Ivory Coast and Brazil.[1/] For the political economy scholar who criticizes neoclassical economists for their fetish concern over getting prices right (removing subsidies and taxes), one only has to provide empirical evidence from Ghana to illustrate what happens when prices are distorted. Ghana's drive to promote large-scale rice farming in northern Ghana in the mid-1970s through taxes, subsidies, and an overvalued foreign exchange rate brought forth imported rice combines in a low wage economy with substantial unemployment and rural underemployment (Winch, 1976). This same mistake is being repeated in 1981 in Ghana's drive to promote state farms and mechanized cotton harvesting. In mid-1981, the official exchange rate of 2.6 Cedis for $ US 1 was in stark contrast to across the border in Togo where it took 33 Cedis to purchase one dollar. So state farms use the 2.6 to 1 ratio to import $100,000 cotton pickers. State farm managers are reporting a financial profit while small private farms cannot even buy fertilizer on the market. Getting prices right is not the answer to Ghana's economic problems but a move in this direction is a prerequisite for economic reform in Ghana.

In summary, there is now substantial evidence that agricultural pricing policies have tended to have an adverse effect on: (1) the gap between rural and urban income, (2) the incentive to produce food and export crops, (3) the ability of governments to establish and maintain food reserves, and (4) employment opportunities in farming, processing, and rural industries. Surveys of agricultural pricing policy include De Wilde's (1980) case studies of Kenya, Tanzania, and Ghana; Bates (1981); Mukui (1979); Lele and Candler (1981); Bovet and Unnevehr (1981); and World Bank (1981b). For a devastating critique of pricing policies in Tanzania, see F. Ellis (1980).

Rural Development Programs

Rural development programs have received a great deal of attention by policy makers, scholars, and donor agencies over the past two decades.[2/] The historical

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[1/] Although these figures display an alarming loss of export markets for Tanzania and Ghana, the decline is overstated because of commodities smuggled out of the country. For example, smuggling of cocoa out of Ghana has long been the farmer's response to harsh taxes. In Tanzania, in 1973/74, it was widely known that farmers smuggled maize across the border in response to lower government producer price of maize. But even if official export figures are understated by 10-15 percent for some commodities such as cocoa in Ghana, the above figures do illustrate how Tanzania's and Ghana's export positions have eroded.

[2/] The distinguishing characteristics of rural development programs are that development is broadly defined to include increased rural welfare as well as increased agricultural productivity and, in many cases, includes the notions of increased participation and broadly shared benefits. See J. Cohen (1980) for a discussion of the definition of rural development.

experience with designing, implementing, and evaluating rural development programs in Africa is vast and would require a separate review. In this section, we shall mention only a few of the important references, starting with the community development literature of the 1950s.

Community Development and Animation Rurale

During the 1950s and early 1960s, rural development was primarily promoted through community development (CD) and animation rurale (AR) programmes. CD emerged from experiences in the United States in the 1930s and 1940s and from England in the form of Fabian socialism after World War II. CD programs were introduced in the British Colonies in the late 1940s with emphasis on building bridges, schools, and health clinics. CD was viewed as a peaceful way to mobilize people to help themselves in meeting their felt needs. India and Pakistan, the Philippines, and Korea were the primary CD laboratories of the 1950s. The rise and fall of the CD experience of the 1950s in Asia is chronicled in Holdcroft's valuable survey (1978). Holdcroft summarizes the reasons for the rapid rise and fall of CD as follows:

1. CD architects overlooked class conflict in rural areas and assumed that CD agents working at the village level could mobilize people to help themselves. But, in practice, a CD worker was an all purpose worker with few technical skills in agriculture and did not have the means to help farmers gain access to credit and the landless to acquire land.
2. Since increasing agricultural production was not the main objective of CD programs, when food crises emerged, governments shifted resources to ministries of agriculture to step up food production.
3. CD was zealously promoted as a separate strategy from agricultural development and, as a result, there was rivalry between the old line ministries--agriculture, health, education--and newly established ministries and departments of community development.

CD was transferred to the Caribbean (e.g., Jamaica) and to several English-speaking countries in Africa by the British colonial service in the 1950s. For an overview and assessment of CD in Nigeria, see Jackson (1956). But CD never received the prominence in Africa in the 1950s that it received in Asia.

Since 1960, a number of francophone countries in Africa have adopted animation rurale as a means of mobilizing and educating their rural populations (Charlick, 1980). AR essentially has played the same role in Francophone Africa as did CD in the former British colonies. For a review of animation rurale programs, see Elliott (1974), Lele (1975), and Charlick (1980). Gellar, Charlick, and Jones (1980) point out that except for a brief period in Senegal AR has been used as a technique for fostering local organization and for non-formal education rather than as a comprehensive rural change strategy. Two of the

key elements of AR are dialogues with villagers and the development of a network of local animators to increase local organizational capability. In his review of AR in Cameroon, Upper Volta, Senegal, and Niger, Charlick argues that in most AR programs animation agents served as promoters for the programs of other technical services instead of helping facilitate development from the bottom up and that nearly all important decisions concerning development programs were made by government agents and then imposed on villagers. By the end of the 1960s, the broadly defined populist mission of AR programs had, in most countries, given way to a more limited role in which AR agencies focused on a few tasks such as informal education (Gellar, Charlick, and Jones).

Although CD or AR agencies are still present in most African countries, they play a limited role in the major policies affecting rural people in Africa. They often serve as scapegoats allowing technical services to ignore the human side of rural production programs. For example, a rural engineer may consider where a dam should be placed to maximize its holding capacity while the CD or AR agent is called upon to generate support for the project among the local population and to try to resolve conflicts in land use rights. In retrospect, both AR and CD movements had two basic flaws: they underplayed the technical constraints and they were too optimistic about the degree of national political support for decentralized development (Gellar, Charlick, and Jones, 1980).

Integrated Rural Development

The 1970s can be labelled the decade of integrated rural development (IRD). IRD projects were introduced in the late sixties and early seventies throughout the Third World in the wake of the acknowledged failure of the Green Revolution to have much impact in Latin America, the Caribbean, and Africa. IRD in Africa received a boost at the famous Kericho Conference on rural development in Kericho, Kenya in 1966, when political leaders emphasized the need to give attention to employment generation and rural development projects (see Sheffield, 1967). Well-known IRD projects in Africa include the Chilalo Agricultural Development Unit (CADU), Wolamo Agricultural Development Unit (WADU), and various minimum package programs (MPP) in Ethiopia, the action priority zones program (ZAPI) in Cameroon, the Lilongwe land development program (LLDP) in Malawi, and the Special Rural Development Program in Kenya. These IRD projects were based on the assumption that a critical minimum effort was necessary to have a noticeable impact on target populations in a short time. The projects were therefore concentrated in a limited area and were administered through semiautonomous agencies which paralleled other government agencies.

Uma Lele's (1975) review of 17 IRD projects in Eastern, Southern, and West Africa in the 1960s and early 1970s is a standard reference. Using a classification system based on degree of integration, breadth of objectives, size of target population, and funding agencies, she identified four major categories of programs, of which the most important are the commodity programs (e.g., the Kenya Tea Development Association) and the regional and national rural development programs. Lele found that most of the projects evaluated were based on inadequate knowledge of technical possibilities and small farm conditions and exhibited little understanding of the local institutional environment. She argued that the key to success of IRD projects is the systematic accquisition of local knowledge and flexibility in the course of implementation. Because of the severe lack of trained manpower, she recommends beginning programs with only the few simple interventions to remove critical constraints and then phasing in other programs. Lele contends that it seems unlikely that the establishment of autonomous project authorities will lead to the achievement of IRD objectives in the long run.

H. Dupriez (1978) reviewed several IRD projects funded by the European Economic Community. Dupriez found that the administrators of these projects tended to regard rural communities as undifferentiated masses and therefore frequently ignored social structures and economic and political hierarchies. Dupriez was critical of the lack of attention given to participation in many projects. For example, he was unable to find a single instance in which decentralization actually allowed farmers an opportunity to participate in decision making affecting projects.

Cohen (1980) analyzed IRD in a historical perspective and found that the common denominators of IRD projects are a focus on small farmers and an attempt to promote improvements in the quality of rural life and increase off-farm opportunities. According to Cohen, the two major gaps in the IRD literature are the weak theoretical foundation and the lack of a strategy to provide guidelines for practitioners. Cohen contends that the increased scope of rural development activities during the 1970s exceeded the design, implementation, and evaluation capacities of national governments and donor agencies.

Starting in the late 1970s, interest in IRD projects rapidly began to decline. In 1980 and 1981, the pendulum shifted from IRD to strategies which emphasize food production by small commercial farmers. The decline of IRD does not reflect a retreat on equity goals as much as growing recognition that pilot IRD programs rarely if ever were implemented on a broader scale, that governments cannot afford to finance a wide range of social services during the early stages of development, and that IRD (like CD in the 1950s) was not solving the most fundamental rural problem--achieving a reliable food surplus. Although many IRD projects will continue to carry the IRD label in the 1980s, we are of the conviction that agricultural production concerns will form the core of these

projects.[1/] Moreover, as Lele (1981) pointed out, the stark reality is that there always was a large gap between the donors' equity-oriented objectives and national governments' goals of long-run modernization, growth, institution-building, and economic independence.

For an assessment of rural development projects in Kenya in the late sixties and the seventies, see Heyer, Ireri, and Moris (1971); University of Nairobi (1975); and Heyer, Maitha, and Senga (1976). For a recent book on IRD in Nigeria, see the volume edited by Olayide, Eweka, and Bello-Osagie (1980). F. S. Idachaba (1981) presents an overview of the lessons from IRD programs in Nigeria. For discussion of rural development projects in Ethiopia, see J. M. Cohen (1975); Tecle (1975); Sisaye and Stommes (1980); and B. Akilu (1980). Hyden (1980) presents an insightful analysis of the Ujamaa program in Tanzania, which stressed rural mobilization and collectivization as an approach to rural development. Tanzania'a rural development experience is well documented in the bibliographies by Kocher and Fleisher (1979) and McHenry (1981). Atayi and Knipscheer (1980) evaluate the ZAPI program in Cameroon. For an overview of rural development policies in Botswana, see Picard (1979). For a skeptical view of IRD, see Ruttan (1975).

Accelerated Food Production Campaigns

During the 1970s, several countries launched accelerated food production programs to reverse the long decline in food production per capita and to reduce dependence on food imports. Paralleling the attempts of Latin American countries to pursue import-substitution industrialization in the 1950s and 1960s, many African nations are finding that "food import-substitution" programs cannot compensate for the long-term neglect of the agricultural sector and overcome the many infrastructural and technical constraints on food and agricultural production. For example, when Ghana launched its "Operation Feed Yourself" in 1972, the government acknowledged that the historical priority on cocoa and oil palm production was a critical factor in the decline of food production. During the early phases of Operation Feed Yourself, the government invested heavily in large-scale farms which turned out to be expensive and ineffective (Nweke, 1978b). Moreover, the program was placed under the Ministry of Agriculture while research on small farmers was in another ministry so there was little coordination of efforts. Finally, Girdner et al. (1980) point out that if self-sufficiency in food could be achieved, Ghana would remain heavily dependent on cocoa for export earnings.

In the early 1960s, Nigeria was a net exporter of food--mainly oil palm and groundnuts--but by the early 1970s, Nigeria was importing food. Nigeria imported 1.4

[1/] See the lack of attention given to regions of poor resource endowments and to equity objectives in the World Bank's (1981) strategy for African development. The Bank's strategy for African development in the 1980s could be labelled as a growth strategy reminiscent of the 1960s.

million tons of basic staples in 1977 and this figure is projected to increase by 1985. The value of Nigeria's food imports in 1981 was $1.3 billion. The prognosis is bleak. There is no easy way for Nigeria to solve its food crisis in less than 10 to 15 years. In evaluating Nigeria's National Accelerated Food Production Program, Abalu and D'Silva (1980b) link Nigeria's present food crisis to repressive marketing board policies and they express little hope that the accelerated food production program will be successful. Nigeria has established a Green Revolution Committee to explore how to speed up food production (Nigeria, 1980a,b). Also a number of important food policy studies have been recently carried out under the leadership of Francis Idachaba (1980b, 1981; and Idachaba et al., 1981). Idachaba points out in Food Policy in Nigeria (1980b) that there is a need to move from ad hoc responses to a policy framework which examines the interrelationships among sectors, subsectors, policy instruments, programs, and projects.

Sudan is one of the most glaring examples of the failure of a country to mobilize its agricultural sector as an engine of growth and to feed its people. In the mid-1970s, it was frequently asserted that the Sudan could become the "bread basket of the Middle East" by drawing on OPEC loans and gifts to develop its vast reserve of idle land (Kiss, 1977). But the issue today is not one of exporting food to the Middle East but one of Sudan's inability to feed its 18 million people. For example, Sudan imported $30 million in US PL 480 food in 1980 and it is now facing severe balance of payment problems and inflation. Sudan's role as the bread basket of the Middle East remains a dream.

West Africa is now importing around 1 to 1.6 million tons of rice each year. Economists from the Food Research Institute at Stanford University and the West African Rice Development Association (WARDA) have recently completed a study of the rice industry in five countries in West Africa.[1/] The Stanford/WARDA study addresses three main issues: (1) the private and social profitability of producing rice, (2) the effect of governmental policies on the production, consumption, and trade of rice, and (3) the potential for increased interregional trade. The findings reported in Pearson et al. (1981) reveal that most techniques of rice production in West Africa are privately profitable but the incentive to grow rice varies greatly among the countries, being the lowest in Mali and Liberia. In terms of deliveries to urban centers, rice was found to be socially profitable only in Mali and Sierra Leone. Even though the social profitability of locally produced rice is greater in remote regions (because of high transportation costs), a substantial proportion of local production in the Ivory Coast, Senegal, and Liberia could not succeed without restrictive trade policies. An interesting finding is that, contrary to general belief, West African governments did not subsidize rice consumers from 1965 to

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[1/] The study centers on the Ivory Coast, Liberia, Senegal, Mali, and Sierra Leone.

1976. During this period, domestic rice prices were from one-quarter to one-third higher than the cif import prices in four of the countries. Mali is the sole exception. The major conclusions of the Stanford/WARDA study are: (1) Mali and Sierra Leone can achieve rice self-sufficiency while promoting efficient use of resources, and with some production and processing techniques could profitably export rice;[1/] (2) the Ivory Coast and Liberia should emphasize other more profitable crops and import rice during periods of deficit, and (3) Senegal needs to concentrate rice production in particular regions (such as the Casamance region in southern Senegal) if it wants to increase food security without a high cost in efficiency.[2/]

Among the bright spots on the food production front are food production programs in Malawi and Zimbabwe (Blackie, 1981). In 1980, Zimbabwe exported 500,000 tons of maize. Zimbabwe's 1981 maize crop is a record 2.5 million tons and approximately 1.0 million tons are available for export. On the other hand, neighboring Zambia is importing a large percentage of maize, its staple food. But the question of food security has an important political dimension. Although Zimbabwe is an exporter and Zambia an importer of maize, they both face a common political problem--the lack of proven maize packages and supporting institutions for small farmers. In Zambia, about 400 commercial farmers produce an estimated 40 percent of the marketable surplus of maize. The Ministry of Agriculture does not have proven maize packages for its 645,000 small farmers (Marter, 1978; CIMMYT, 1978). Should Zambia press on with achieving self-sufficiency in maize via commercial farmers or small farmers? Unlike the Sahelian Zone of West Africa, where the long-term prospects of rainfed farming are not favorable, the long-term prospects for helping small farmers are favorable in Zambia. But can Zambia survive politically in the short-and intermediate-run while it relies on commercial farms? The same question confronts Zimbabwe (see Bratton, 1981). How much does one sacrifice in terms of efficiency in order to transfer resources to small farmers?[3/]

[1/] The Stanford study showed that the social profitability of rice production in Sierra Leone was positive because of extremely low rural wage rates. But over the 1974-1981 period, rural wage rates have doubled from 1 Leone to 2 Leones per day and Sierra Leone's rice imports increased to 41,000 tons in 1980. The question of Sierra Leone becoming a rice exporter now appears to be mute.

[2/] But a word of caution is in order. The five countries studied only have a total population of 26 million--or one-third of the total population of Nigeria. It is risky for the authors to discuss West African rice trade without including Nigeria in their study.

[3/] For a discussion of the SADCC strategy to achieve food security in the southern African region, see Kgarebe (1981).

Synthesis

The overriding policy issue of the postindependence period has been the ideology of economic development--capitalism, state capitalism, or agrarian socialism. Regardless of whether economies are organized along the lines of capitalism, state capitalism, or socialism, in most countries the state will continue to intervene actively in the pricing and marketing of agricultural commodities.

During the late 1960s, a consensus emerged that macro-planning and the transformation approach to agricultural development were not working. Therefore, most governments turned to small farmer strategies of agricultural development and many governments initiated integrated rural development projects. Because of lagging food production in most countries during the 1970s, support for IRD began to wane in the late 1970s and numerous countries launched crash food production campaigns. The empirical record thus far is not encouraging. The prospects of dramatically increasing food production in the short run are dismal in almost all African countries in the face of long-term neglect of the agricultural sector.

It is more evident than ever that long-run food and agricultural development strategies must be built on a solid foundation of micro research on small farmers, traders, and herders. We now turn to a survey of micro research on smallholder farming, technical change, and livestock.

IV. SMALLHOLDER FARMING

The purpose of this chapter is to identify some of the major institutions carrying out micro-economic studies on smallholder farming, discuss methodological issues in conducting rural surveys, evaluate analytical techniques used by agricultural economists in analyzing survey data, and present empirical findings for the 1960-81 period. A word of caution is in order. We obviously cannot go into depth on research in all of the countries included in this review. The publications cited are illustrative of research completed over the past 20 years. These studies will help identify research gaps and in defining research agendas for the 1980s.

Overview of Institutions Carrying Out Farm Level Studies

Prior to the 1960s, research by agricultural scientists in sub-Saharan Africa focused on export crops and commercial farming. Little was known about the socioeconomic aspects of subsistence farms except for studies by anthropologists, geographers, and a handful of studies by agricultural economists.[1/] In the 1960s, a number of research institutes were established and there was a large increase in the research on the economics of smallholder farming. This overview identifies some of the major institutions carrying out farm level studies over the 1960-81 period.

Several African governments and universities initiated farm management and socio-economic surveys in the 1960s. The Farm Economic Survey Unit (FESU) in Kenya began conducting research on large estates in 1958 and undertook its first survey of smallholders in the 1961-62 cropping season. For a review of the FESU farm survey program, see MacArthur (1968). In Kenya, the Institute of Development Studies and the Department of Agricultural Economics of the University of Nairobi have made a major contribution to knowledge about Kenya's agricultural economy (Heyer, Maitha, and Senga, 1976); small farmers (Heyer, 1971); extension and diffusion of innovations (Ascroft et al., 1972); rural development (Heyer, Ireri and Moris, 1971); dairy industry (Hopcroft and Ruigu, 1976); and fertilizer (Mwangi, 1978).

In Tanzania, M. P. Collinson (1962-64) carried out surveys of small farms in Sukumuland District in the 1960s. The Economic Research Bureau, the Department of Agricultural Economics, and the Bureau of Resource Assessment and Land Use Planning (BRALUP) of the University of Dar es Salaam have carried out a wide range of farm level studies. For bibliographies on Tanzania, see Kocher and Fleisher (1979) and McHenry (1981).

[1/] A few important studies did provide information on the economics of agricultural practices. See, for example, Haswell (1953); Galletti, Baldwin and Dina (1956); Leurquin (1960); and Boutillier et al. (1962).

In Malawi, three sets of surveys were conducted from 1962 to 1965. One focused on a few progressive farmers in each of 12 districts. Later a random survey of cotton growers was carried out in three villages. The third approach relied on weekly visits to farmers. Each enumerator was responsible for only eight farms (Catt, 1966). In the late 1960s, the Agricultural Economic Survey (AES) program was given primary responsibility for farm level research in Malawi. See Farrington (1975b) for a review of the survey approach used in the AES.

In Uganda, D. Belshaw, D. Pudsey, M. Hall, and J. Cleave carried out a number of surveys in the 1960s. For reviews and assessments of farm level research in East Africa through the early 1970s, see Hall (1970), Collinson (1972), and Cleave (1974).

There has been a long history of research in Zambia (formerly northern Rhodesia) dating from surveys initiated by the Department of Agriculture in the 1930s in collaboration with the Rhodes-Livingstone Institute of Social Studies (see W. Allan, 1965; A. Richards, 1932, 1939). The University of Zambia sponsors research through its Institute of African Studies (see Colson, 1971; Quick, 1978) and the Rural Development Studies Bureau (Honeybone and Marter, 1975; Marter, 1978). In Zimbabwe (formerly southern Rhodesia), farm level studies were carried out by A. W. Johnson (Massell and Johnson, 1968). The University of Zimbabwe's Department of Land Management is currently carrying out a wide range of studies of irrigation, tobacco, and marketing (see M. Blackie, 1981).

Turning to West Africa, the Department of Agricultural Economics at the University of Ibadan in Nigeria carried out a large number of farm management and marketing studies in the 1960s under the leadership of H. A. Oluwasanmi, Martin Upton, and Q. B. O. Anthonio. Rufus Adegboye (1969, 1977) was one of the first African agricultural economists to point out the strategic importance of research on land tenure issues. An innovative socioeconomic survey was carried out in Uboma village in eastern Nigeria in 1963-64 and reported in Oluwasanmi et al. (1966). Ibadan researchers also carried out numerous studies of marketing boards and supply response during the 1960s. Later, under the leadership of S. O. Olayide, O. Ogunfowora, and F. Idachaba, the Ibadan group carried out major studies of employment, income distribution, and agricultural policy in the 1970s.

A village studies research program was initiated by David Norman and his colleagues at Ahmadu Bello University (ABU) in northern Nigeria in 1964. The results of these studies have made a major contribution to our understanding of intercropping, constraints on small farm production and marketing systems, and consumption patterns (Norman, 1972; Goddard, 1972; Abalu, 1976; Simmons, 1976a,c). For a description of the survey approach used, see Norman (1973) and Abalu and D'Silva (1980a).

Since 1962, the Institute of Statistical, Social, and Economic Research (ISSER) of the University of Ghana, Legon, has carried out important studies on food production (C. K. Brown, 1972), consumption (Dutta-Roy, 1969), and the cocoa industry (Kotey, Okali, and Rourke, 1974). Also, some of the most valuable studies of demography in Africa have been carried out by demographers at the University of Ghana (see Caldwell, 1969; Caldwell et al., 1975).

In Francophone West Africa, the Senegalese Institute of Agricultural Research (ISRA) in Senegal and the Institute of Rural Economy (IER) in Mali have been active in village studies. The emphasis of both programs has been on forging a link between farmers and research stations. In the 1970s, ISRA established "experimental units" or research zones in the groundnut basin in an effort to demonstrate the potential of introducing new technology that had been developed on the main research station at Bambey. For an overview of the experimental unit program in Senegal, see ISRA (1977); Faye and Niang (1977); Benoit-Cattin (1980); and Fall (1980a). IER publications in Mali include Institut d'Economie Rurale (1977) and Traore (1980).

Since the mid-1960s, researchers from numerous American and European universities have carried out farm level studies in collaboration with local researchers in universities and in government research institutes. The Food Research Institute of Stanford University, for example, carried out an inter-disciplinary study of agricultural change in six English-speaking countries in sub-Saharan Africa in 1965/66 (Kenya, Uganda, Tanzania, Zambia, Ghana, and Nigeria). Survey results were reported in Anthony and Uchendu (1970, 1974) and Uchendu and Anthony (1975a, 1975b). A summary is reported in Anthony et al. (1979).

In Southern Africa, the University of Nottingham collaborated with the University of Zambia in conducting farm surveys in two areas in Zambia in the late 1960s. The focus of the UNZALPI[1/] project was to identify approaches for increasing the labor productivity of small farmers. Survey results were reported in Elliott et al. (1970). Tench (1975) also used UNZALPI survey data.

The University of Reading sponsored farm level research in Botswana in the mid-1960s, in Malawi in collaboration with the AES, and in Ghana with the University of Legon. Thornton (1973) summarized the findings of the village development project in southeast Ghana. Palmer-Jones (1974) reported the results of a study of tea production and marketing in Malawi.

In Sierra Leone, a national farm survey was carried out by Njala University College and Michigan State University in 1973-75. The results were presented in Spencer and

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[1/] Universities of Nottingham and Zambia Agricultural Labor Productivity Investigations.

Byerlee (1976, 1977) and Byerlee et al. (1977, 1982). A survey of 480 rural households in the Eastern Region of Upper Volta was carried out by a Michigan State University research team over the 1978-80 period. The results are reported in Barrett et al. (1982), Lassiter (1981), and Wilcock (1981).

Since 1976, Purdue University has been conducting surveys in West Africa to evaluate: (1) the economics of sorghum and millet production in the Sahelian countries, and (2) the costs and benefits of small- and medium-sized irrigation perimeters. Major findings were presented in Purdue (1980).

The University of Michigan has carried out studies in West Africa, focusing on livestock (Shapiro, 1979; Ariza-Nino and Steedman, 1979, 1980), grain marketing (Berg, 1980; Sherman, 1981), and mixed farming in Upper Volta (Delgado, 1979a, 1980) and Niger (Eddy, 1979).

The University of Bordeaux began multi-disciplinary survey work in the Maradi Region of Niger in 1977. De Miranda and Billaz (1980) and Raynaut (1980) discuss their survey methodology and preliminary findings.

Farm level research in sub-Saharan Africa has also been assisted by a network of international and regional research institutes. The West African Rice Development Association (WARDA) with its headquarters in Monrovia, Liberia was established in 1960 to promote cooperation in the development of rice improvement programs in 15 French and English-speaking countries. Currently farm level studies of rice production systems are underway in Mali, the Gambia, and the Ivory Coast under the supervision of WARDA agricultural economist--Dunstan Spencer.

One of the most important international organizations to support farm level research in Africa since the early 1960s has been the Institute for Economic Research (IFO) in Munich. In the 1960s, IFO focused on East Africa but by 1980 more than 100 monographs had been published in their "Afrika-Studien" series covering many of the English-speaking African countries. Most of the studies deal with agriculture and nearly half are in English. See, for example, Ruthenberg (1968), Gusten (1968), Kraut and Cremer (1969), Roider (1971), Chambers and Moris (1973), and Lagemann (1977).

The Scandinavian Institute of African Studies at Uppsala has published a wide range of studies on cooperatives (Widstrand, 1972); tobacco production (Boesen and Mokele, 1979); women (Bukh, 1979); multinational firms (Widstrand, 1975); and rural development (Chambers, 1974).

The Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM) in Paris has a network of around 20 research centers covering most of the francophone countries in sub-Saharan Africa. Publications by ORSTOM researchers include Kohler (1971, 1972)

in Upper Volta, Ancey (1974) and Ancey, Michotte, and Chevassu (1974) in the Ivory Coast, and Copans et al. (1972), Delpechi and Gastellu (1974), and Rocheteau (1975) in Senegal. See Couty and Hallaire (1980) for an overview of ORSTOM studies during the 1960-80 period.

The International Institute of Tropical Africa (IITA), established in 1968 at Ibadan, Nigeria, has carried out technical and socioeconomic research on the major food crops in the humid tropics. Studies by IITA researchers include Robinson (1974); Flinn, Jellema, and Robinson (1975); Lagemann, Flinn, and Ruthenberg (1976); Lagemann (1977); Okigbo and Greenland (1977); Bachmann and Winch (1979); Fotzo and Winch (1978); Diehl and Winch (1979); Flinn and Lagemann (1980); Menz (1980); and Zuckerman (1977, 1979a,b,c).

In 1976, CIMMYT launched a program in Eastern and Southern Africa under the leadership of Michael Collinson to help improve national research systems through training and farming systems research on the problems of small farms. The farming systems studies emphasize the rapid collection and processing of data. CIMMYT's goal has been to publish results in 6 to 12 months in order to channel information on the problems of farmers into the design of on-station research programs and to develop on-farm experiments in order to test promising technologies under farm conditions. Although the research focus is on the economics of wheat and maize, the crops under CIMMYT's mandate, the farm level studies provide valuable information on other crops such as sorghum, millet, cassava, cotton, and cowpeas. CIMMYT's cooperative studies in Kenya, Tanzania, and Zambia are reported in CIMMYT (1977a, 1977b, 1978) and Collinson (1982).

ICRISAT started a cooperative research program in Upper Volta in 1975 with a sorghum breeder followed by a plant pathologist, millet breeder, two agronomists, a striga specialist, and an entomologist. A production economist was added in 1979 and farm level research was started in 1980.[1/]

In addition to the above research programs and projects, research findings based on farm level studies during the 1960-81 period are reported by the following researchers:

East Africa: Heyer (1966, 1971, 1972a); Catt (1970); Hutton (1973); Richards, Sturrock, and Fortt (1973); Shapiro (1973); Saylor (1974); Vail (1975); Humphrey (1975); Hunt (1975a); Gerhart (1975).

Central and Southern Africa: Massell and Johnson (1968); Atayi and Knipscheer (1980); Tollens (1975); Weinrich (1975); Perrault (1978); Marter (1978); Kinsey (1978).

[1/] ICRISAT has sponsored valuable literature reviews on production systems (Norman, Newman, and Ouedraogo, 1981) and marketing (Harriss, 1979a,b) in the semi-arid tropics of West Africa and a conference on socioeconomic constraints on development of semi-arid tropical agriculture with reference to Africa and India (ICRISAT, 1980a).

West Africa: Meillassoux (1964); Welsch (1965); Pelissier (1966); Luning (1967); Upton (1967); Hill (1968); Smock and Smock (1972); Capron (1973); Monnier et al. (1974); Maymard (1974); Berry (1975); Kleene (1976); Winch (1976); Marchal (1977); Matlon (1979); Faulkingham (1977); Reyna (1977); Sawadogo (1977); Zuckerman (1977); Venema (1978).

Methodological Issues in Rural Surveys

Issues in Survey Design

Since most small farmers are illiterate and do not keep farm account books,[1/] three methods have been used to generate information: (1) case studies, (2) infrequent surveys, and (3) cost route or multiple visit surveys (Spencer, 1972). The case study or model farm approach provides descriptive information on a single farm or a number of farms purposively selected to be representative or to reflect the practices of progressive farmers. Infrequent visit surveys[2/] entail visiting a farm once or a few times to collect a range of stock (inventory) data and information about current practices. In the cost route (or multiple visit) approach,[3/] farmers are visited regularly by an enumerator over an entire cropping season or full year, generally one to three times weekly and from 50 to 150 times a year. The rationale for using the cost route approach is that it is an effective way to capture flow (input/output) data on the magnitude and variability of labor--the most important input on small farms.

During the 1960s, researchers in East Africa used all three approaches--case studies, infrequent surveys, and cost route surveys--to collect farm-level information (Hall, 1970). Clayton (1963), for example, used a model farm approach, drawing on data from government farms. Researchers in the Farm Economic Survey Unit in Kenya used a model farm approach in their whole-farm studies, based on data drawn from interviews with progressive farms (MacArthur, 1968). Heyer (1966) used a case study approach, relying on intensive observations on a small sample of farmers in Kenya. Researchers in Tanzania used farm business type surveys on a large number of randomly selected farmers (Collinson, 1962-64). In Uganda, researchers from Makerere University and the Ministry

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[1/] There have been occasional attempts to use literate children to keep rudimentary records (MacArthur, 1968) but this approach has largely been abandoned in Africa.

[2/] There are numerous terms such as reconnaissance, exploratory, informal, and farm business surveys for what are essentially infrequent visit type of surveys. The farm business survey terminology is a western concept which was used in some African countries in the 1960s but the term was subsequently dropped.

[3/] Cost route derives its name from the repeated nature of the survey over the course of a year in order to derive data to compute costs and returns of production.

of Agriculture used a cost route approach, interviewing randomly selected farmers three times weekly for the entire crop year (Pudsey, 1967).

During the late 1960s and early 1970s, the case study approach was largely abandoned by agricultural economists in English-speaking countries and researchers shifted to surveys and random sampling to ensure that input/output data reflected typical farm-level conditions. Although some researchers such as Collinson (1972) continued to advocate infrequent visit surveys, the prevailing opinion was that the cost route approach should be used if there were time, money, and administrative capacity (Kearl, 1976). The rationale for cost route surveys can be traced to the 1960s when labor was identified as a major constraint on smallholder production in Africa. Advocates of the cost route approach such as Dunstan Spencer (1972) were aware of difficulties that one-shot surveys had in coming to grips with the seasonality of labor use and argued that frequent visits by enumerators were necessary to capture the seasonality of labor use and to control measurement errors on the labor variable. The cost route method was widely used in farm management surveys during the 1970s (Norman, 1972; Matlon, 1979; Winch, 1976; Fotzo and Winch, 1978; Shapiro, 1973; Elliott et al., 1970; Spencer and Byerlee, 1976; Zuckerman, 1979a; Purdue University, 1980). In order to reduce the cost of multiple visit surveys, multi-stage sampling procedures were employed by numerous researchers. In this approach, stock data are collected in a reconnaissance survey of a large population, often several hundred households, and in the second stage, a smaller sample is randomly selected for repeated surveying in order to collect flow data over a period which often covers 12 months (Norman, Newman, and Ouedraogo, 1981).

Cost route or multiple visit surveys have thus far provided the most reliable data on input flows, particularly labor inputs, but this type of survey is substantially more costly per farm interview than one-shot surveys. As a result, there is a trade-off between sample size and visiting frequency. While it has been recognized that one-shot surveys will likely have high measurement errors for variables such as labor, the cost route or frequent interview methodology has a number of inherent problems. For example, the cost of interviewing the same farmer 50 to 150 times a year is extremely high, and there is a problem of sustaining the interest of the farmer during repeated interviews. Moreover, it often requires 6-12 months to plan a cost route study, a year to carry it out, and sometimes 2-3 years to analyze and publish the results. Concern with the cost of cost route surveys and the need to generate rapid results has led to a search for survey methodologies which can produce results in a few months rather than 2-3 years.

Starting in the late seventies, there was a discernible shift from cost route to infrequent visit surveys. These infrequent visit surveys, now more commonly called

exploratory or informal surveys, are popular among some advocates of farming systems research such as Byerlee, Collinson et al. (1980) and Collinson (1981, 1982). Although there is clearly a need to expand the use of infrequent visit or informal surveys for more rapid identification of major constraints on production, no one has yet identified a method to collect reliable information on seasonal labor use through one-shot surveys. Because labor is the most important input on small farms, designers of improved technical packages need data on labor use by crop, by activity (e.g., weeding, ridging), and by week during a few critical periods in the year.

Two approaches have emerged to deal with the conflicting goals of quick turn-around time and reliable labor data. One approach is to incorporate the best features of infrequent visits and cost route surveys into a new approach such as the activity approach which was tried by Pascal Fotzo in his 1980-81 study of rice production in eastern Upper Volta. Fotzo recorded data once on each activity (e.g., land preparation, planting, and weeding) involved in the production of bas fond rice over a six-month period.[1/] A second approach is to prepare case studies for a small sample of farmers--say 30--from only one or two villages (Matlon, 1980). The recent emphasis, by some farming systems research teams, on combining survey research with anthropological type case studies has been stimulated by increasing acceptance of the view that an understanding of farming systems requires more than the input of economists and more than the computation of averages from a farm survey. But whatever method is used to collect data a basic problem is one of collecting far too much information. Farrington (1975b) and Abalu (1980) point out that the frequent lag between data collection and publication of results is often caused by the collection of far too much information.

The approach to farm-level studies has been significantly different in francophone than in English-speaking countries. In Francophone Africa, farm-level researchers have generally carried out case studies on a small number of farms rather than large-scale rural surveys. Although we classify the approach often used by French researchers and French-trained researchers as a case study approach, we do not mean that statistical surveys are never used. For example, Boutillier et al. (1962) used a one-shot questionnaire in which farmers were asked to recall information for the preceding year; they also collected daily information for a seven-day period twice during the year on such variables as expenditures and food consumption. But where formal attempts have been made to

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[1/] While the activity approach is promising, it may not reduce survey costs unless there is detailed information available on the cropping calendar since farmers have to be interviewed to see if an activity is completed. But data processing costs are reduced and the researcher can benefit from insights gained through informal interviewing even though the informal interviews are not formally recorded (Fotzo, personal communication, Department of Agricultural Economics, Michigan State University).

quantify key variables, sample sizes are generally extremely small and households are often selected on a non-random basis with the limited goal of deriving numbers for descriptive purposes, as opposed to sampling for statistical inference.[1/] Copans et al. (1972) and Delpechi and Gastellu (1974), for example, report surveys in which the samples were 10 to 12 adults representing 2 to 4 compounds.

Methodological debates in francophone countries have focused on alternative conceptual frameworks for understanding social structure and social relationships and how they affect the organization of production. One of the major issues debated during the seventies was whether studying the production unit (exploitation agricole) is sufficient to explain the dynamic forces affecting the decisions of small farmers or whether studies at different levels--clans, villages, age groups, etc.--can provide more reliable information. The term exploitation agricole refers to a production unit where people work together on the main food grain field and eat as a group from the output of the main field (Ancey, 1975). While English-speaking researchers undertaking survey research have generally relied on the household as the unit of analysis (often defined as "people who eat from the same pot") researchers in francophone countries consider the question of the proper decision unit to investigate to be an important unresolved issue (Monnier et al., 1974; Maymard, 1974; Ancey, 1975; Kleene, 1976; Couty, 1979; Gastellu, 1980). For example, Ancey (1975) argued that a single sampling unit such as exploitation agricole was not broad enough to capture the multi-dimensional relationships affecting decision making on African farms. He contended that different groups of decision makers operate at different levels--individual fields, consumption groups, main field production, residence, lineage, village, and supra-village--and that decisions of these various units often overlap and compete with others. Based on survey experience in Senegal, Gastellu (1980) argued that the starting place in survey research is to identify the units of production, consumption, and accumulation, rather than relying on a single concept such as exploitation agricole. He proposes that in order to identify these groups, researchers should (1) evaluate who makes the main decisions in each activity, (2) evaluate the syntax of the local language in order to discern obligations and expectations between people, and (3) focus on identifying patterns of privileged exchanges-- food, gift, and labor, as well as money.

[1/] French researchers have often expressed the view that sample surveys are a tool of statisticians which may be selectively used to supplement the qualitative understanding of farmers provided by social science researchers using techniques such as participant observation, recording life histories, and constructing geneologies (Couty, 1979; Benoit-Cattin, 1980).

The value of using the individual rather than the entire production unit as a unit of analysis has been stressed by Winter (1975), Rocheteau (1975), Kleene (1976), Couty (1979), and Raynaut (1980). Raynaut argued, for example, that by taking into account differences between individuals, researchers can better distinguish the roles that physical and technical factors play in socioeconomic strategies of different household members.

References on Survey Design

In presenting results, researchers generally have devoted little space to justifying the approaches they followed in collecting and analyzing survey data. But the choice of data collection and analysis procedures may importantly influence survey results. For example, the decision to use open-ended questionnaires as opposed to structured instruments can exert a major influence on the results obtained. Open-ended questions allow farmers to identify problems in their own words but tend to introduce intractable problems in the analysis and interpretation of data. On the other hand, more structured schedules may reduce ambiguity in interpretation of data but the choice of wording will frequently bias the replies.[1/] A large body of wisdom about designing rural surveys is now available. A review of these reports should be the starting place for researchers contemplating farm-level research.

Collinson (1972) reviewed methodological problems in collecting and analyzing farm management data for planning purposes, drawing primarily on his early experience in Tanzania. Spencer (1972) drew on his experience in conducting farm management and marketing studies in Sierra Leone to discuss methodological problems in collecting flow data. Norman (1973) reviewed his experience in directing farm-level surveys in northern Nigeria. A volume edited by Kearl (1976) contains a valuable discussion of field data collection experiences by numerous African researchers. Farrington (1975b) reviewed the data collection methods used by the Agro-Economic Survey Unit in Malawi with emphasis on labor flow information. More recently, Zuckerman (1979a, 1979b) has discussed the approach used by IITA researchers in western Nigeria in the early 1970s. Abalu (1980) critiqued cost route surveys in West Africa. For a discussion of infrequent (informal) surveys, see Byerlee, Collinson et al. (1980) and Collinson (1982).

[1/] Additional survey design issues which may influence survey results include: (1) selection of the sampling frame, (2) procedures used for gaining knowledge of local farming practices in order to design questionnaires, (3) approaches for securing support and cooperation of interviewees, (4) choice of direct measurement techniques--primarily for field size, yields, and intensity of labor use--to supplement recall information, (5) alternative methods for gathering information about sensitive issues such as the size of land holdings or livestock, buildings, and credit, and (6) methods for making field data checks to reduce inconsistency and to verify recorded responses.

A discussion of methodological issues in rural surveys in several francophone countries can be found in AMIRA's "notes de travail."[1/] Ancey (1975) presented a valuable picture of the complex organization of small farms. Winter (1975) and Thenevin (1978) identified different survey techniques in gaining information for economic planning. Couty (1979) presented a general overview of methodological issues encountered using socio-anthropological approaches to farm-level research. Raynaut (1980) and De Miranda and Billaz (1980) discussed multi-disciplinary surveys of farms in Maradi, Niger. Building on his research experience in Senegal and the Ivory Coast, Benoit-Cattin (1980) outlined a non-statistical survey approach to study how economic, technical, social, and ecological variables interact to affect the organization of work on farms.

Data Processing

Processing of survey data has posed a major problem for researchers throughout Africa. There has been a tendency to collect a wide range of data, paying little attention to how the data is to be analyzed until after data collection is finished (Abalu, 1980). As a result, portions of the collected data are frequently never even keypunched, let alone analyzed. Moreover, the effort required to validate and aggregate data into files for analysis has often led to delays of one to three years before preliminary results are published. Researchers are slowly starting to realize that data processing must be considered as an integral part of the entire survey design, data collection, and data analysis chain of events. Data processing can take as many resources as data collection but most manuals on survey methodology pay little attention to processing problems. In addition, even though many African countries now have computer facilities, most computer centers have limited capacity and access to software packages.

Several major decisions have to be made at or before the beginning of data cleaning and validation. Often, little attention is given to the following two critical issues: (1) how to stratify sample households into appropriate groups for subsequent analysis, and (2) how to convert labor into a homogenous unit in order to make labor files more manageable (Norman, 1972). Several approaches have been used for stratification. In many cases, particular regions or villages have been purposively selected at the data collection phase, reducing the need for ex post stratification. Clayton (1964) and

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[1/] AMIRA is an informal working group of researchers from ORSTOM, INSEE, and the French Ministry of Cooperation who have had extensive farm-level research experience in francophone Africa. The group was formed in 1975 with the specific purpose of debating and refining data collection methods. Four main issues are addressed in the AMIRA papers: (1) what information to collect, for what uses, and for what objectives; (2) how to collect the relevant information; (3) how to process and analyze the data; and (4) how to use the information to improve decision making. (See Winter, 1978.)

Collinson (1972) advocated stratification by land per resident because capital use by traditional farmers is limited. Researchers at Ahmadu Bello University stratified their surveys in northern Nigeria: (1) by village or section, and (2) by land per resident. The IITA 1970-71 survey in western Nigeria used age of the farmer to stratify their surveys (Zuckerman, 1979a). Researchers have often relied on land tenure patterns, ethnic groups, or agro-ecological zones to stratify samples of farms. For example, agro-climatic zones were the main means of stratifying survey data by Barrett et al. (1982) in Upper Volta and in Sierra Leone by Spencer and Byerlee (1976). Ancey (1977) classified 25 farm models in the Sahelian zone of West Africa mainly on the basis of farm size, as well as ecological characteristics. Poulain et al. (1979) stressed the use of ecologically homogenous zones, and within each zone distinguishing among households using land availability and the presence or absence of livestock.

There has been a clear dichotomy between francophone and anglophone countries in the treatment of labor (Norman, Newman, and Ouedraogo, 1981). Studies in francophone countries generally rely on a stock measure of labor called the actif, primarily because of their heavy emphasis on case studies. An actif is often defined as a person between ages 15 and 54 or 59. The actif concept tends to understate the stock of labor available for agricultural activities, particularly in peak seasons when most persons over 10 years work in fields. If the proportion of labor coming from individuals under 15 and over 54 is significantly different among sub-samples of households, the net return per actif will be overestimated in the households where non-actifs make a major contribution to farming activities. Also the actif concept does not make any allowance for differences in productivity and labor use by seasons (Ancey, 1974). Examples of studies which have used the actif approach include Kohler (1971) and Monnier et al. (1974) in Senegal; and Barrett et al. (1982) in Upper Volta.

In studies in Anglophone Africa, researchers have generally aggregated labor units using the concept of "man-equivalents." The concept of man-equivalents was applied to stocks of labor in early research in Tanzania in order to discount the inputs of women and children since it was assumed their labor was less productive than that of men (Collinson, 1962-65; Ruthenberg, 1968). More commonly, indices reflecting productivity difference have been used to convert flow inputs by women and children into man-hours or man-days. Most studies have used fairly arbitrary approaches for deciding on the weights to be used in aggregating labor inputs and, as Collinson (1972) noted, there has been controversy over how to derive appropriate weights. Norman (1972) contended that a work study approach is an objective way to assign weights. Spencer and Byerlee (1976) used wages in rural labor markets to derive relative weights. In a 1978-79 survey in eastern Upper Volta,

weights were obtained by asking a sample of farmers to estimate the relative productivity of different classes of labor defined by age and sex for each major cropping activity (Barrett et al., 1981).

The need to speed up the processing of survey data has emerged as one of the dominant factors affecting survey design and data processing strategies. Quicker turn-around times necessitate better coordinated data collection and processing. Norman and Palmer-Jones (1977), for example, call for a more standardized economic methodology for research on cropping systems. The FAO has developed a terminology for farm management concepts in French, English, and Spanish and has also developed pre-coded questionnaires and a standardized computer program (Friedrich, 1977). This program can be used in different ecological zones and countries to generate partial and whole farm budgets, crop and livestock enterprise tables on a farm-by-farm basis, as well as the usual sample averages.[1/]

Micro-computers, costing $4,000 to $15,000, have great promise for data cleaning, validation, and preliminary analysis of survey data. Purdue University used micros in their West African research in Mali, Senegal, and Upper Volta. Morris reports (in Purdue, 1980) that local programming skills are a bigger constraint than hardware problems. Mini-computers (larger than micros and costing around $100,000) have been used in the World Bank financed evaluation studies in northern Nigeria. While small computers will undoubtedly play a major role in future research in Africa, much more experience with both hardware and development of software packages will be needed before they will match the claims of the manufacturers. In any event, the use of small computers cannot solve the turn-around problem unless researchers stop collecting excess data (Candler and Slade, 1981).

Applications of Analytical Techniques

Budgeting

Farm budgeting is a standard farm management technique which was introduced in a large number of countries in English-speaking Africa in the 1960s.[2/] Whole (total) farm budgets were used to derive performance standards for extension programs (MacArthur, 1968). During the 1970s, researchers shifted to enterprise budgeting except in areas where there was extensive intercropping. Enterprise budgeting was used to (1) compare

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[1/] The initial FAO farm management program (FMDCAS) has been updated with a second version (FARMAP). The new version is based on a modular design in order to be more flexible.

[2/] Kenya (MacArthur, 1968); Tanzania (Collinson, 1962-64; Ruthenberg, 1968); Uganda (Pudsey, 1967); Malawi (Catt, 1966); Nigeria (Upton and Petu, 1964; Upton, 1967); and Senegal (Boutillier et al., 1962).

the costs and returns of different crop and non-farm enterprises (Lagemann, 1977; Ruthenberg, 1980; Spencer, Byerlee, and Franzel, 1979; Lassiter, 1981); and (2) to compare costs and returns in producing the same crop with different techniques (Winch, 1976; Spencer and Byerlee, 1976; Lang, 1979). A few researchers have used partial budgeting to evaluate changes in enterprise mix or production techniques (Fotzo and Winch, 1978). We shall concentrate on whole farm and enterprise budgeting.

Numerous methodological issues need to be addressed in constructing budgets from cross-sectional data (Dillon and Hardaker, 1980). Four major problems have repeatedly surfaced in deriving budgets, making it difficult to interpret and compare the results of different studies. First, no standard approach has been used in deciding what to include in farm budgets. For example, many researchers have only included yields of the main crops, arbitrarily excluding secondary crops, livestock, and non-farm activities. Few researchers have taken into account changes in stocks or have attempted to estimate the opportunity costs of farm supplied inputs such as manure. Furthermore, there has been little consistency in the treatment of land; some researchers included all land under the control of the farm, other studies used only land owned or land cultivated in the year of the survey.

Another problem in budgeting studies has been the valuation of inputs and outputs. Because small farmers generally purchase few inputs and retain a major proportion of farm output for family consumption, returns are highly dependent on the value researchers assign to inputs and outputs. Both measuring and valuing family labor pose major problems in constructing farm and enterprise budgets. A few researchers have presented results using a range of assumptions such as not including the cost of any family labor during different times of the year, including the cost of only hired labor and inputing a cost for all labor (Norman, Pryor, and Gibbs, 1979). More commonly, researchers have treated hired labor as a variable cost, included a charge for land, and then computed a net return to labor and management as a residual (Ruthenberg, 1980; Spencer, Byerlee, and Franzel, 1979). Even this approach is fraught with difficulties. How does one value labor in situations where farmers rely on reciprocal labor exchanges, providing meals for guest workers as partial payment? Another issue is whether to include time walking to and from fields. Most studies have ignored walking time even though in some cases it can be substantial (Cleave, 1974).

The problem of valuing capital services is equally difficult. The most common practice has been to exclude costs of capital for hand implements. Straight line depreciation is often used for major capital items. Spencer and Byerlee (1976) and Spencer et al. (1979) used a capital recovery formula to convert capital stocks to annual service flows taking into account the average life of the equipment and a discount rate assumed to approximate the social opportunity costs of capital.

The value of outputs has usually been derived by multiplying average yields over the sample of farms by the average annual price in local markets. Use of a simple average of observed prices throughout the year can substantially misrepresent the actual average prices received by farmers because prices can fluctuate by more than 100 percent during the year. Moreover, sales are often concentrated in the post-harvest period when prices are lowest. Another common problem in valuing outputs is whether to attribute the value of intercropped fields to individual crops or to treat the crop combination as a single enterprise.

A third problem is interpreting budgets that have been constructed from average input/output relationships on surveyed farms. Averages, as Upton and Casey (1974) and Dillon and Hardaker (1980) point out, can obscure wide variations in soil characteristics, managerial ability, class differences, access to inputs, and other variables which can greatly influence the returns to any given farmer. Moreover, as Ruthenberg (1980) has warned, budgets built from averages of survey data generally show a more diversified production pattern than one is likely to observe on any individual farm. Ruthenberg contended that data from a model or typical farm are often more useful than survey data from farm budgets. G. E. Dalton (1973) points out that while net income figures derived from farm budgets provide useful descriptive information, they do not provide insights into the factors responsible for poor performance of a single enterprise or the reasons for low productivity on an individual farm.

Finally, budgets based on cross-sectional data do not take account of changes over time and space. Because of inflation, overvalued exchange rates and changes in relative prices of crops over time, figures such as the cost of plowing with tractors or the returns to labor in rice farming are generally not comparable in different countries and in different years. Also, net income figures do not provide adequate information on the welfare of rural households unless data are also available on the cost of living. Because of periodic droughts and wide variations in the timing of rains, weather can greatly influence the returns to land and labor in any given year. Finally, land clearing activities and time spent planting perennial crops add value to production in future years but trying to identify the returns to that labor poses an accounting nightmare.

Despite our stress on data limitations and problems of valuation, farm budgeting is a valuable tool of analysis. Budgeting and comparative farm indices were found to be invaluable in farm survey research in the 1960s in large part because they could be constructed relatively quickly and the training requirements for building and interpreting budgets is limited relative to programming and regression methods. Ruthenberg's (1980) invaluable farming systems book attests to the descriptive value of comparative farm

budgets. Enterprise budgets have contributed to our understanding of relative costs and returns in fallow and permanent cultivation systems, from improved versus traditional production practices, from perennial and annual crops, and for farming and non-farm activities.

Regression Analysis

Econometric studies of smallholder production relationships can broadly be divided into three categories: (1) farm production functions; (2) analyses of the determinants of levels of resource use; and (3) supply response studies.

Farm Production Functions

Production function studies in the 1960s were few and far between and of uneven quality. Interest in this topic was stimulated by the desire to evaluate smallholder productivity and efficiency in order to test Schultz's "poor but efficient" hypothesis (Schultz, 1964). Production functions estimated from controlled survey data and data from experiment stations have also been used to analyze factors influencing yields of recommended technical packages and to identify optimal levels of resource use for new practices.

To our knowledge, the earliest reported attempts to estimate production functions for smallholders from survey data appears to be in the case studies of Tanzanian agriculture reported in Ruthenberg (1968), Massell and Johnson's (1968) analysis of African farmers in Zimbabwe, Upton's (1967) research in southwestern Nigeria, Welsch's (1965) study of rice farmers in eastern Nigeria, and Luning's (1967) study of sorghum-millet-groundnut farmers in northern Nigeria. During the 1970s, efforts to evaluate determinants of farm household income using regression techniques have been carried out in numerous countries, including Zambia (Elliott et al., 1970; Tench, 1975), Nigeria (Upton, 1970; Norman, 1972; Norman, Fine et al., 1976c; Matlon, 1979; Osuntogun, 1978; Norman, Pryor, Gibbs, 1979; Mijindadi, 1980), Kenya (Saylor, 1974; Wolgin, 1975; Rukandema, 1978; Moock, 1981), Tanzania (Shapiro, 1973; Shapiro and Muller, 1977), Sierra Leone (Spencer and Byerlee, 1976), the Ivory Coast (Lang, 1979), Malawi (Farrington, 1975b, 1977a), and Ghana (Prakah-Asante, 1976).

After almost two decades of experience in estimating smallholder farm production functions using survey data, there are still many unresolved problems. Since production function studies have relied on survey data of uneven quality, overcoming data limitations has been one of the major determinants of the approaches followed in specifying production functions. Major specification problems have included: (1) choice of a functional form and (2) measurement and aggregation of inputs and outputs. The choice of functional form has received surprisingly little attention in discussions about the

specification of production functions. Most researchers have used Cobb-Douglas functions, generally with little or no discussion of why alternative functional forms were not considered. A few researchers have presented comparative results using linear, quadratic, and square root functional forms (Ruthenberg, 1968; Luning, 1967; Tench, 1975; Shapiro, 1973). Spencer and Byerlee (1976) used a CES production function to evaluate returns to scale and the elasticity of substitution between labor and capital services in rice production in Sierra Leone. In a series of studies conducted by researchers at the Institute for Agricultural Research, Zaria, Nigeria, several functional forms were used: linear for yield functions, quadratic or linear for estimating the relationship between profits and yields, and Cobb-Douglas to evaluate the marginal value products of inputs (e.g., Norman, Beeden et al., 1976a, 1976b).

Almost without exception, farm production functions have been estimated using ordinary least squares. Three exceptions include Massell's use of analysis of covariance (Massell and Johnson, 1968; Massell, 1967b), Spencer and Byerlee's use of non-linear maximum likelihood estimation of their CES function, and Strauss' (1981) household firm model using survey data from Sierra Leone. The production component of Strauss' simultaneous equation model is Cobb-Douglas in inputs and constant elasticity of transformation in outputs. The model was estimated using a tobit model in order to account for some products not being produced by all households.

In general, the dependent variable in farm production functions has been total farm income from all cropping activities.[1/] Limitations of survey data have largely prevented estimation of crop-specific production functions. Yields from separate fields or from individual crops in crop mixtures have typically been converted to value terms using an average of annual prices in local markets. In a few cases, returns per acre instead of total farm income has served as the dependent variable. In the few cases where production functions have been estimated for specific crops, one or a few crops either accounted for most of the area cultivated or were important sources of cash income (Massell and Johnson, 1968; Spencer and Byerlee, 1977; Saylor, 1974). Yields of specific crops have also served as the dependent variable in studies using experiment station data or data from controlled surveys (Norman, Beeden et al., 1976a, 1976b; Norman, Hayward, Hallam, 1974, 1975; Flinn and Lagemann, 1980).

[1/] We refer to the research cited in this section as production function studies even though many studies are not based on physical production functions of particular crops since this terminology has been consistently used in the literature in Africa.

Data problems have forced researchers to rely on inadequate representation of aggregate input categories--land, labor, capital--[1] in estimating inter-farm production functions. In some early studies, stock variables were used to represent flow inputs in cases where flow data were not available. Ruthenberg (1968), for example, used family man-equivalents as a proxy for labor. Massell and Johnson used the value of farm implements at undepreciated replacement cost to represent capital. Upton (1967) represented capital investments by acres of tree crops and number of livestock. Even in cases where flow variables have been included, it has been common to use undiscriminating units such as man-equivalent days (Upton, 1967; Lang, 1979).[2]

Because of specification and measurement problems, the coefficient of multiple determination of most farm income studies based on aggregate physical farm inputs has been low and the standard deviations of individual coefficients have been large. Researchers have followed two major approaches in trying to increase the amount of income which is explained by their models. First, several researchers have abandoned efforts to rely exclusively on variables representing underlying physical production functions and have included indices of social and personal characteristics as well as physical input variables (e.g., Upton, 1967, 1970; Elliott et al, 1970; Shapiro, 1973; Saylor, 1974; Tench, 1975; Rukandema, 1978). Upton (1967) was one of the first researchers to analyze the relationships between production, consumption, and social characteristics. Upton used Guttman scaling to rank farmers by factors such as progressiveness and correlation analysis was then used to evaluate the strength of relationships between social characteristics and production.

One of the first studies to formally incorporate social variables into functions of the value of farm output was based on farm survey data collected in Zambia under the UNZALPI Project. Elliott et al. (1970) incorporated indices to represent factors such as education, general awareness, and knowledge of farming and attempted to attribute proportions of the explained production per acre to social variables instead of the usual farm inputs. Tench (1975) presents a valuable discussion of conceptual and statistical issues involved in evaluating smallholder productivity in Zambia. In addition to estimating a basic Cobb-Douglas model relying on aggregate input categories for land, labor, and

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[1] In several cases, capital has been left out because (1) there was little variation in the use of capital across farmers, (2) little capital was used by farmers except a hand hoe, or (3) farmers who used fertilizers or insecticides used them improperly (Ruthenberg, 1968; Shapiro, 1973; Lang, 1979).

[2] There is substantial evidence that both the length and intensity of the working day vary significantly during the year (Norman, 1972; Cleave, 1974; Farrington, 1975a; Shapiro, 1978).

capital, Tench explored alternative formulations, including (a) inclusion of several indices of social and personal factors and (b) regressing the value of output on a set of variables representing only social and personal factors. Surprisingly, Tench found that the multiple coefficient of determination based on social and personal indices was nearly as large as the coefficient based on the usual physical inputs. Tench (1975) also used the technique of principal components analysis to identify a set of social, personal, and technical variables which were most closely associated with variation in the value of farm output. Using survey data from Tanzania, Saylor (1974) used stepwise regression to analyze the relationship between output per hectare and per unit of labor and several technical variables such as the time of planting, plant densities, and ridging as well as social variables such as modernity and contact with extension workers.

Researchers have also attempted to improve the specification of their models by disaggregating land, labor, and capital into more specific components. Upton (1967) and Norman, Pryor, Gibbs (1979) decomposed labor into family labor and hired labor. More commonly, labor has been decomposed by either age-sex category (Shapiro, 1973, 1978; Tench, 1975) or by cropping operation (Shapiro, 1973; Saylor, 1974; Rukandema, 1978). Specification of land has been improved by incorporating dummy variables for soil quality and fertilizer use. Capital has been divided into cash expenditures and depreciation on capital equipment (Norman, 1972).

One of the major methodological issues in specifying farm production functions has been the decision as to whether to include a variable for management. Attempts have been made by Massell and Johnson (1968), Upton (1970), and Shapiro (1973) to derive proxies for management in order to reduce the specification bias that arises when management is correlated with included variables. Massell and Johnson used survey data from two areas in Zimbabwe, the Cheweshe Reserve and Mt. Darwin District, to fit Cobb-Douglas production functions for each of the three major crops--groundnuts, millet, and corn. Farmers were interviewed weekly for the entire crop year. Massell and Johnson attempted to reduce management bias by use of analysis of covariance and by incorporating dummy variables to distinguish three groups of small farms by management level. A discussion of the procedures used in the analysis of farms in the Cheweshe Reserve and major findings was also presented in Massell (1967a). Massell (1967a) represented management differences using dummy variables; he later drew on data from the Mt. Darwin District to illustrate his method for reducing management bias through the use of analysis of covariance (Massell, 1967b). Massell treated each firm-product combination as a separate observation, making the assumption that the relative efficiency of farmers is constant across all the crops they grow.

Upton (1970) used the technique of principal components analysis to derive a single index as a proxy for management. Shapiro (1973) derived several indices for social and personal characteristics using Guttman scaling and then combined the indices into a single index whereby farmers were ranked according to their degree of "modernization." Because there was a high correlation between the modernization ranking and a farmer's ranking in terms of technical efficiency, Shapiro argued that the modernization index could be used as a proxy for management efficiency. In estimating production functions for his sample of farmers in Geita District, Tanzania, Shapiro experimented with several specifications, both including and excluding the management variable. Shapiro concluded that the effect of including management was to raise the productivity of labor and to decrease the productivity of land. Shapiro and Muller (1977) expanded on Shapiro's analysis by incorporating indices of information in their analysis of farmer efficiency.

Although the above research by Massell, Upton, and Shapiro represented important methodological contributions, researchers have largely abandoned the use of a management variable and have tried to incorporate management indirectly through variables such as the timing of key activities (e.g., date of planting, date of weeding) and by specifying variables reflecting the quality of inputs to account for differences in "technical efficiency" among farmers. In production function studies for maize, cotton, and sorghum, sowing date, plant density, amount of fertilizer, and time from sowing to weeding have been found to have significant relationships with yields (Norman, Beeden et al., 1976a, 1976b; Norman, Hayward, Hallam, 1974, 1975). In their recent research on maize production in Nigeria, Flinn and Lagemann (1980) found that coefficients of variables representing the timing of field activities--especially the date of planting--proved to be more significant and more stable than variables representing the level of labor inputs.

In summary, due to data limitations, and consequent estimation procedures and specification problems, the results of production function studies should be considered as rough approximations to be treated with caution, as several researchers have acknowledged (Ruthenberg, 1968; Massell and Johnson, 1968; Shapiro, 1973; Norman, Beeden et al., 1976b; Upton, 1979).

Determinants of Resource Use

The second major use of regression analysis has been to identify factors affecting the level of resource use by farmers. Applications have focused on determinants of (1) the amount of land cultivated or labor used in farming activities, or (2) the rate of diffusion or probabilities of adoption of a recommended input such as fertilizer or an improved variety.

In general, regression analyses of factors affecting labor or land use have depended on somewhat ad hoc selection of variables to be included as regressors. A limited amount of the variation in resource use is generally explained in these applications. The major purpose of these regressions has been to test hypotheses in order to improve an understanding of farming system relationships. Using simple linear regression, Upton (1967) and Luning (1967) demonstrated a positive and significant relationship between the number of people available for farming activities and the area cultivated. Norman, Pryor, and Gibbs (1979) estimated several regressions relating to levels of resource use, including hours worked per hectare, total hours worked on the family farm, and hours worked per hectare in northern Nigeria. Man-hours per acre were found to be inversely related to the number of acres cultivated but positively related to the proportion of higher quality land. Also, as might be expected, the authors were able to show that total family hours devoted to work on the farm was directly related to the size of family and area cultivated and inversely related to use of hired labor. On the other hand, days worked per male adult on the farm was inversely related to the number of male adults available to work.

Farrington (1975a) used farm survey data in Malawi collected in the 1970-71 and 1971-72 cropping seasons to test the hypotheses that the length of the working day varies according to the type of worker and the type of crop operation. The main regressors were proxies for the energy requirements of a cropping operation and the urgency with which task had to be performed. Farrington found that energy requirements had a stronger influence on the length of the working day than did urgency, but the model explained only a small amount of the observed variation in the length of the working day.

Researchers have included a wide range of independent variables in studies of adoption patterns. Gerhart's (1975) study of maize diffusion in Kenya took into account such factors as population density, proximity to a research station, average annual rainfall, education, knowledge of credit, number of extension visits, and farm size and found that agroclimatic zone was the most important variable in explaining adoption. Binary dependent variable models have been used to evaluate factors affecting the decision to adopt improved technologies. Falusi (1974/75), for example, used a multivariate probit model to analyze factors affecting the decision to use fertilizer in Nigeria. Aklilu (1980) used a logit model in his study of fertilizer adoption in Ethiopia.[1/]

Supply Functions

Since the mid-1960s, numerous studies have been carried out on the magnitude and direction of smallholders' supply response for a wide variety of cash crops. Evidence on

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[1/] See also "Agricultural Extension " in Part IV.

supply response for food crops continues to be scarce and largely impressionistic. Supply response studies of smallholder cash crops have focused on two questions: (a) is there evidence of positive short-and long-run price elasticities? and (b) are price elasticities high enough that statuatory marketing boards could use pricing policies to influence the composition of smallholder production? Positive price elasticities have been reported in every case, although the results have not always been statistically significant. Elasticities have been found to be low with long-run price elasticities being somewhat higher than short-run elasticities. For summaries of empirical findings, see Askari and Cummings (1976) and Helleiner (1975).

Numerous methodological problems have plagued supply response studies and debates about appropriate estimate procedures have been heated.[1/] Many methodological weaknesses can be traced to data limitations. For example, almost all time series data for estimating supply functions have come from marketing board records but these figures do not distinguish between aggregate supply response and board purchases. Moreover, reliance on marketing board data has made it difficult to take planting dates of perennial crops into consideration. As a result, most studies have focused on marketed output as opposed to more refined analyses of acreage and yield response. Although many studies have incorporated a weather index (usually rainfall) or a trend variable to reflect technical change (Olayide, 1972; Oni, 1969a), few have been able to take into account labor, land, or liquidity constraints even though each could have a major impact on yields and marketed output (Berry, 1976; Adegeye, 1976).

G. K. Helleiner (1975) noted the following common methodological problems in his review of supply response studies: (1) prices received by producers may differ significantly from reported marketing board prices, (2) few studies have convincingly defended the underlying models, (3) in several cases only one of the possible forms of supply relationships has produced significant results and the form of the lead equation for the same crop has usually been different in different studies, and (4) only a few studies have taken income and liquidity constraints into consideration. Berry (1976) points out that because researchers have rarely bothered to explore the possibility that their statistical findings may be consistent with more than one model empirical findings have shown little more than farmers do respond to market forces .

Through the early 1970s, the major methodological issues in supply response studies were (1) validity of using marketed output as opposed to planting decisions in constructing supply response models for perennial crops, and (2) how to handle producers' price

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[1/] See, for example, Ford's (1971) critique of Maitha (1969, 1970); Gemmill's (1979) critique of Medani (1975) and Medani's (1979) reply; and Blandford's (1973) comment on Olayide (1972) and Olayide's (1974) rejoinder.

expectations for both perennial and annual crops. Several researchers acknowledged the desirability of using acreage as the dependent variable but had to use output since acreage figures were not available (e.g., Bateman, 1965). Stern (1965) used data on cocoa plantings in Nigeria from before 1945 to estimate a planting response model but, as Berry (1975) points out, Stern's model was crude, relying on five-year moving averages of plantings and the real price of cocoa. Berry (1976) used data from Nigeria, from 1911 to 1944, to evaluate an alternative model of cocoa supply; she showed that the rate of planting was more closely related to farmers' income from cocoa sales than it was to current price. Berry concluded that liquidity constraints were more important to Nigerian cocoa producers than future price expectations as long as the opportunity costs of planting more trees are not prohibitive.

Kenya is one of the few countries where time series data on plantings of cash crops and smallholder yields are available. Maitha (1969) derived a tree stock demand function from an aggregate CES production function to explain annual variations of mature acreage of coffee. Farmers were assumed to determine their acreage so as to maximize the present value of net receipts. Maitha subsequently presented an alternative model (1970) by using output per acre as the dependent variable.[1/] Etherington (1973) formulated a polyperiod production function for tea, incorporating such variables as past plantings, maintenance and harvesting inputs, and the botanical characteristics of the crop. Output in any one year was then treated as a function of the distribution of past plantings and the estimated yield from each cohort group. Etherington contended that actual output could be closely predicted by introducing climatic and/or economic factors specific to a given year.

Several approaches have been used to represent producers' price expectations. Bateman's (1965) research in Ghana was one of the first supply studies of a perennial crop to use a Nerlovian adaptive expectations model. Alibaruho (1974) also used a Nerlovian model in his study of cotton supply in Uganda. More commonly, either proxy variables or lagged producer prices have been used to represent expected prices (e.g., Maitha, 1974). Ady (1968) used world prices in a West African comparative study on the grounds that, even though producer prices were determined by marketing boards, the world price affected producers' price expectations. Olayide (1972) included current world prices in his study of Nigerian cash crops for the same reason but this was criticized by Blandford (1973) as being a poor substitute for expected producer price.

[1/] Both models were estimated independently using OLS and combined to derive an elasticity of price for total output. Ford (1971) contended that Maitha's failure to estimate acreage and yield function simultaneously led to an overestimate of price elasticities of yields for estates (plantations) and for the industry as a whole.

Stern (1965), as mentioned above, used a five-year moving average of real cocoa prices in his analysis of cocoa plantings in Nigeria. Fredrick (1969) and Oni (1969a) used simple lagged prices to represent price expectations in studies of cotton in Uganda and Nigeria, respectively. Both included prices of major substitute crops as well. Fredrick also estimated cotton output as a function of the price ratio of cotton to coffee. Saylor (1967) and Alibaruho (1974) also used price ratios to represent price expectations.

During the 1970s, the attention of researchers shifted from grinding out elasticities using basic lagged price models to developing more refined models of farmers' supply response. Several refinements have been suggested, including (1) incorporating asymmetric price response (Olayemi and Oni, 1972; Olayemi, 1976); (2) taking into account production and prices of food crops in estimating cash crop supply functions (Alibaruho, 1974); (3) simultaneous equations models (Ford, 1971; Blandford, 1973); (4) distinguishing between marketable surplus and total output response (Medani, 1975; Livingstone, 1977c; Gemmill, 1979); and (5) taking into account non-price factors in estimating the determinants of output response (Adegeye, 1976; Helleiner, 1975; Abalu, 1975).

In summary, supply response studies have provided irrefutable evidence that smallholders are economic men and they do incorporate price factors into their production decisions. But the discovery of a positive correlation between the price of a commodity and sales to a marketing board tells us very little about small farmer decision making (Helleiner, 1975; Berry, 1976). Although some refinements have been made in supply response modeling in recent years, we agree with Helleiner (1975) that research on the price responsiveness of smallholders has reached a point of diminishing returns.

Supply response studies by commodity are as follows: cotton (Oni, 1969a; Fredrick, 1969; Aldington, 1971; Olayide, 1972; Alibaruho, 1974); cocoa (Bateman, 1965; Stern, 1965; Ady, 1968; Behrman, 1968; Olayide, 1972; Olayemi and Oni, 1972; Berry, 1976); coffee (Ady, 1968; Fredrick, 1969; Maitha, 1969, 1970); palm oil and kernals (Helleiner, 1966a; Saylor, 1967; Oni, 1969b; Olayide, 1972); tobacco (Dean, 1966); rubber (Olayide, 1972; Olayemi, 1976); and groundnuts (Olayide, 1972; Abalu, 1974; Owosekun, 1976).

Programming Models

The first application of linear programming to African agriculture was Clayton's (1961) study of the effect of resource constraints on the profitability of typical farms in the Central Province of Kenya. The study was based on secondary data and was limited in the number of activities and constraints considered since Clayton had to derive optimal plans by hand. Despite methodological problems, Clayton made a valuable contribution in identifying family labor rather than land as the major constraint on increasing farm output. In a follow-up study using a computer in England, Clayton (1963) used parametric programming to indicate the effect of differing resource endowments on farm profitability and to derive a normative supply curve.

Heyer's (1966) programming analysis of Kenyan agriculture represented a major improvement over Clayton's work by (1) using input/output data collected from farmers and (2) introducing a range of activities for crops to reflect differing production intensities. Heyer's research also identified labor as the major constraint on smallholder farming, clearly demonstrating the need to look beyond returns to land in evaluating potential technical packages. Later, Heyer (1971) refined her LP model and showed that the introduction of cash crops--cotton and a quick maturing variety of maize--would have a modest impact on the incomes of subsistence farmers in semi-arid zones of Kenya.

During the 1970s, linear programming (LP) models emerged as one of the most important tools used by researchers studying smallholder farming. Major applications have included:

(1) identification of constraints on smallholder farming (Clayton, 1961, 1963; Heyer, 1966, 1971; Atta-Konadu, 1974; Abalu, 1975; Richard, Fall, Attonaty, 1976; Perrault, 1978; Delgado, 1979a,b; Traore, 1980; Crawford, 1982);

(2) derivation of normative supply and input demand functions (Ogunfowora, 1972; Ogunfowora and Norman, 1973; Mwangi, 1978; Metson, 1978);

(3) estimation of frontier production functions on the basis of cross-sectional farm survey data (Shapiro, 1973; Mijindadi, 1980);

(4) evaluation of the profitability of new technologies (Ogunfowora and Norman, 1974; Vail, 1973; Hopkins, 1974; Singh, 1976; Kinsey, 1978; Etuk, 1979); and

(5) identification and evaluation of management strategies (Heyer, 1972; Low, 1974; Farrington, 1976; Niang, 1980).

In general, the goal of researchers conducting LP studies of the first type--identification of farm level constraints--has been to provide direction to policy makers rather than attempting to recommend improved plans for individual farmers. Models generally have been based on an abstract "representative" or typical farm. Researchers have typically used average values obtained through farm surveys to determine both resource constraints and input/output coefficients for the representative farm. Coefficients for new technologies usually have been based on experiment station trials, sometimes discounted to approximate responses under farm-level conditions. Most models have been designed to maximize expected profits from cropping activities and have included subjective constraints, particularly a minimum subsistence food requirement, as well as resource constraints.

In addition to the well-known limitations of LP (Dillon and Hardaker, 1980), three major problems have been encountered in the studies reviewed. First, the assumption of profit maximization, even when constrained by minimum food requirements and by setting resource constraints to the average of observed values, has led to model results which

bear little resemblance to observed patterns of resource allocation. Second, few researchers have considered the problems involved in inferring region- or country-wide policy implications from the results of individual farm models.[1/] Third, most LP models have only taken into account optimal plans for annual crops over a one-year horizon, ignoring inter-annual resource flows, household activities, interaction between farming and animal husbandry, and the cash flow problems associated with the introduction of large capital purchases--e.g., animal traction, including oxen and equipment. Notable exceptions include Abalu (1975), Delgado (1979a,b), and Crawford (1982). Delgado evaluated the possibility of mixed farming in southern Upper Volta as an alternative to the current entrusting system between the Mossi who specialize as farmers and the Fulani who specialize as herders. Delgado found that the opportunity cost for either group engaging in mixed farming could not justify abandoning the entrusting system. Abalu (1975) used a dynamic programming model to identify the optimal sequence of investments in perennial crops on public, cooperative, and traditional farms in Cameroon over a 20-year horizon. The objective function was to maximize the present value of the 20-year stream of benefits from investments in perennial crops, subtracting a constant proportion of the income generated each year for consumption expenditures. Abalu found land to be the only limiting constraint.

Crawford (1982) creatively combined multi-period programming with simulation of stochastic variables in an attempt to assess the effect of variable crop yields, physical resource limitations, and family size on growth of incomes and consumption over a multi-year horizon. An optimal solution was found for a one-year horizon at the beginning of period one using a multi-period model, and then a random number simulator was used to adjust several key variables, including expected yields, investment returns, consumption requirements, and crop prices, which were fed forward into a second multi-period model covering the remaining periods of the year. Resources available at the end of the year after all household requirements had been met became the right-hand variable for the subsequent year, enabling Crawford to simulate the interaction between farm decisions, resource constraints, and the uncertain environment over a several-year horizon.

The second category of applications, derivation of normative supply and input demand functions, has been employed to predict farmer responses in cases where time series data are not available (e.g., Clayton, 1963; Ogunfowora, 1972) or in which existing use of an input is limited (Ogunfowora and Norman, 1973; Mwangi, 1978). These studies have generally relied on a representative or "benchmark" farm. Resource demand and output supply functions are derived through parametric programming and, in some cases,

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[1/] For example, Palmer-Jones (1979) has criticized LP studies because of the aggregation problems.

continuous functions have been obtained through regression analyses of derived output-price observations (e.g., Ogunfowora, 1972). In general, the aggregation bias inherent in using representative farms has not been adequately addressed in these studies. Odero-Ogwel and Clayton (1973), in an attempt to construct a regional planning model for Nyeri District, Kenya, tried to reduce aggregation bias by identifying relatively homogenous groups of farms defined by similar factor endowments. Their approach was to use parametric programming to established bounds on land/labor ratios for each ecological zone within which the shadow price for land, the limiting factor, was the same.

The third major application, estimation of a frontier production function, has been used by Shapiro (1973) and Mijindadi (1980) in order to derive an index of technical efficiency. In both studies, the coefficients of a frontier Cobb-Douglas production function were obtained following the method presented by Timmer (1970). An index of technical efficiency was then derived for each farm by dividing actual output by the potential output for that farm given the level of resource use, where the potential output for each farm was calculated by multiplying the resource level of that farm by the coefficients of the frontier production function.

Attempts to use programming models to evaluate new technologies appear to be one of the most promising applications of individual farm models.[1/] Vail (1973), for example, attempted to identify what package of innovations, consistent with farmers' values and financial resources, had the greatest promise for increasing net farm income in Uganda, taking into account different seasonal rainfall patterns and cash crop prices. Similarly, in northern Nigeria, Ogunfowora and Norman (1974) used a programming model to evaluate the relative stability of sole and mixed cropping systems under different resource endowments and husbandry practices in an effort to determine whether technical researchers should give more attention to mixed cropping in designing appropriate technical packages.

Finally, increasing dissatisfaction with the unrealistic policy prescriptions obtained from models designed to maximize profits in a certain environment has stimulated several researchers to develop models which more nearly reflect decision processes of small farmers. Thus far, models in this category primarily have been used for methodological research, although some researchers (Low, 1974) have presented policy recommendations. Heyer (1972), using a game theoretic framework, evaluated differing strategies for dealing with risk and uncertainty, including maximin, minimax, and attempting to maximize expected returns during best, worst, and average years. She then compared model results for different states of nature with farm plans observed in her farm survey.

[1/] Although, it again must be noted that the models used to date have varied greatly in their sophistication and care must be used in interpreting policy recommendations.

Low (1974) also used a game theoretic approach but assumed farmers follow a maximim decision criteria. The maximim decision criteria was entered as a constraint, assuring the subsistence food requirement would be met in the most adverse state of nature, while the objective function was to maximize expected profits under three equally probable states of nature.

Farrington (1976) attempted to provide a better test of the approach used by Heyer (1972) by drawing on survey data collected from two sites in Malawi over consecutive cropping seasons.[1/] Farrington identified optimal farm plans for good years and bad years. Comparing the results with actual farmer practices, Farrington found that farmers adhere to a cropping pattern which, although producing returns somewhat lower than potential in both good and bad years, gave acceptable returns in both types of years. He concluded that such a strategy was consistent with long-run profit maximization.

Farrington's research touched off a debate between Palmer-Jones and Low over the appropriate use of LP to analyze optimal resource use in smallholder agriculture (Palmer-Jones, 1977a, 1979; Low, 1978). On the basis of survey work in northern Nigeria, Palmer-Jones (1977a) contended that the value of LP in analyzing smallholder decision making was limited because farmers adjust the quality and timing of operations as the cropping season progresses. Palmer-Jones also criticized the use of individual farm models for appraising new technologies since the effects of a new technology on the social system might result in an increase in total output but a reduction in the welfare of target groups.

Niang (1980) reports on recent efforts at Purdue University to derive more realistic programming models of small farms in West Africa. A major feature of Niang's model of small farmers in Mali is the division of the household into multiple decision makers, better representing the system of decentralized decision making typical of most ethnic groups in West Africa.

The wave of the future in LP is toward more sophisticated farm level models.[2/] The unanswered question is whether models can be developed and adapted for specific environments at a justifiable cost.[3/]

[1/] Heyer was forced to supplement her survey data with data from experiment stations in order to estimate input/output coefficients under different states of nature.

[2/] Simulation modelling may have even greater potential for increasing the representativeness of farmer decision making, including multiple goals and resource constraints, and the process of sequential adjustment to stochastic events, particularly rainfall. But there have been few attempts to build simulation models at the farm level (see, for example, Zuckerman, 1979c) and therefore the trade-off between the value of more refined farm models and their costs is a priority research methodology issue.

[3/] See Hardaker (1979) for further discussion of alternative analytical techniques used in farm management research in developing countries.

Research on Selected Topics

Social and Cultural Issues

Agricultural development is a product of the interaction of technical, market, and social/cultural variables. While agricultural scientists concentrate on technical and economists on market variables, anthropologists and sociologists examine how variables such as social structure, extended family, and custom inhibit or facilitate the process of change.[1/] Since the literature on social and cultural factors and agricultural development is vast, we shall sample a few studies which shed light on three issues: (1) class analysis and rural change; (2) social impact analysis; and (3) the role of indigenous knowledge in promoting development.

Class Analysis

Class analysis has been a theme stressed by a small but growing number of researchers in their examination of how classes affect the pattern of development and who benefits from technical change, development projects, and foreign aid. A basic question is whether African farmers are homogenous and can be described as the rural poor or whether there are significant, if perhaps almost invisible, class differences within villages. Polly Hill (1968) addressed this question in her widely cited case study of a Moslem village in northern Nigeria, in which she challenged the economists' view of uniform poverty or what she called the assumption of the amorphous peasantry. She concluded that rural inequality may be the norm in the village she studied and (by implication) throughout northern Nigeria. She contended that inequality was caused by historical and political forces and she speculated that inequality could be a source of change if the large farmers and traders would help pull up the disadvantaged in the village. To be sure the presence or absence of rural inequality requires far more empirical data than provided by Polly Hill's study of one village, but she has encouraged economists to reassess their typical assumption that poverty is uniform and that there is a classless rural society. Other studies on rural inequality include: Post (1972); Berry (1980); and Derman and Derman (1973).

French researchers have been in the vanguard in probing the question of class formation and inequality resulting from the transition from subsistence to semi-subsistence and commercial production. Foremost is Meillassoux's (1964) classic study of the economic anthropology of the village of Gouro in the Ivory Coast. Raynaut (1973, 1977) stressed the social disruption of villages and family relationships during the transition from subsistence to commercial farming in central Niger. Kohler (1971) is typical of the

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[1/] For an appraisal of the relevance of contemporary anthropology by a Sudanese anthropologist, see Ahmed (1979).

French researchers who argue that farm and village problems can only be understood as part of the overall rural social structure. He contended that quantitative economic analysis is justified only when farmers are substantially engaged in commercial production.

Studies of class analysis have shed new insights on the process of change in rural Africa. The relationship between class and development projects is explored in Steeves' (1978) study of the Kenya Tea Development Authority and some of the case studies in the volume Rural Development in Tropical Africa, edited by Heyer, Roberts, and Williams (1981). Kitching's Class and Economic Change in Kenya (1980) provides a reappraisal of Kenya's economic history from 1905 to 1970. Class domination in Africa is analyzed in relation to class formation and consolidation in Sklar (1979).

Social Impact Analysis

The analysis of the social consequences of technical change and resettlement projects has been explored by many anthropologists, sociologists, and a few economists over the past two decades. Standard references on the social impact of resettlement projects are Chambers (1969); Roider (1971); and Colson (1971) and Scudder and Colson (1979). Since 1956, Scudder and Colson have carried out longitudinal research in Zambia on the resettlement of the 57,000 Gwembe people following the construction of the Kariba Dam on the Zambezi and Kalue Rivers in Zambia and Zimbabwe (then Rhodesia). The pioneering longitudinal research carried out by Scudder and Colson in Zambia clearly illustrates the need for natural, physical, medical, biological, and social scientists to work together both on pre- and post-settlement impact analyses.

Pioneering social impact studies in Ethiopia are G. Ellis' (1972) analysis of tractor mechanization in the Ada district and J. M. Cohen's (1975) analysis of the impact of the Swedish-assisted CADU Rural Development Project on tenant farmers in the early 1970s. Both Ellis and Cohen showed that tenant farmers and landless laborers were displaced by tractor mechanization, a fact that was suppressed by the Ministry of Agriculture. Another pioneering study is D. S. C. Spencer et al. (1976) analysis of the social and economic consequences of moving from hand pounding to capital-intensive rice processing plants in Sierra Leone. The study revealed that a possible outcome of shifting from hand pounding to total mechanized rice processing would be the elimination of the equivalent of 40,000 full-time rural jobs which were mostly held by women.

Unfortunately, some of the social impact studies are impressionistic. For example, Franke and Chasin's (1980) Seeds of Famine is the product of a five-month tour of Sahelian countries. Swift (1981) notes that Franke and Chasin give an unduly rosy picture of conditions in the Sahel in pre-colonial times and fail to provide solid data on important segments (e.g., livestock economy) of the contemporary economic conditions in the

region. The authors do not provide hard facts to support their grand hypothesis that the spread of the market economy underdeveloped the Sahel and that recovery programs are laying the seeds of future famines. Boesen and Mohele (1979) analyzed the expansion of smallholder tobacco production in Tanzania for the international market and concluded that smallholders were being exploited by international market forces. The failure of the authors to discuss how changes in relative prices and tax policy affected tobacco and alternative crops such as maize raises serious questions about the validity of their findings. If social impact analysis is to gain credibility, it should be incorporated into the pre-design phase of projects (ex ante phase) and it must be adequately funded. If these two guidelines are not followed, then "quick and dirty" ex post social impact studies will be ignored by planners and policy makers. A promising start is CIMMYT's use of an anthropologist in the planning and execution of informal surveys as part of their research on farming systems (Collinson, 1982).

Indigenous Knowledge

In the late 1970s, there was a sudden explosion of literature on indigenous knowledge systems, including "traditional" farming practices. Examples of research on indigenous knowledge include A. W. Johnson's (1972) study of experimentation by traditional farmers, Vermeer's (1970, 1979) pioneering studies of experimentation among Tiv farmers in the middle belt of Nigeria; Coward's (1977) analysis of indigenous irrigation management systems; Swanson's (1980) study of sorghum and millet farmers in Upper Volta; research on intercropping by Norman (1974), Abalu (1976), and Belshaw (1979); the IDRC seminar on intercropping (Monyo et al., 1976); and the valuable collection of papers Indigenous Knowledge Systems (1980) edited by Brokensha, Warren, and Werner. Indigenous knowledge can be a valuable input into research on farming systems, integrated pest management, soil fertility, and livestock systems. A better understanding of the goals and decision making of African farmers will also help bury perjorative terms such as traditional farming and traditional farmers. Unfortunately, these terms imply passive farmers who would suddenly become modern farmers if they had access to new technology (Cleave, 1977). But, as we have pointed out, there are many structural barriers and macro policies which are responsible for poverty, stagnation, and the nonadoption of technical packages.

Land Tenure

Land tenure in sub-Saharan Africa can be characterized as a communal tenure system of public ownership and private use rights of land. In this system, communities control access to land and individuals appropriate the use of land, the products, and have

descent rights to land.[1/] The combination of private use rights and communal control over access to land allows families to (a) have continued use of the same land over time, and (b) the right to buy and sell land and rights to trees (e.g., oil palm and cocoa) through a system of pledging (Adegboye, 1977). But in actual practice, there is not an active rural land market in most countries. One of the few areas where individual freehold tenure is well established is in the Buganda region of Uganda. Richards, Sturrock, and Fortt (1973) argue that the individualized tenure system has greatly facilitated the establishment of commercial agriculture in Buganda. Individual tenure is often criticized because it is thought to contribute to increasing farm size, inequality, and to a landless class (Van Hekken and Van Velzen, 1972).

Unlike Asia and Latin America, landlord and landless classes are not present in most of sub-Saharan Africa because of low population density, abundant land, and colonial policies which prevented white settlers and foreign firms from acquiring titles to land in some countries. A notable exception was the landlord/tenant system in Ethiopia prior to the 1974 revolution and subsequent redistribution of land. The control over land is a crucial political and economic issue in countries such as Zimbabwe where an estimated 6,500 commercial farmers occupy one-half of the land and produce an estimated 94 percent of the marketed surplus (Zimbabwe, 1981; Blackie, 1981) and in Zambia where an estimated 300 commercial farmers produced about 40 percent of the marketable surplus of maize in 1980. The economic question in countries such as Zimbabwe and Zambia involves the trade-off in transferring land from commercial farmers to small farmers and the potential reduction in the marketable surplus.

Until recently, most studies of land tenure in sub-Saharan Africa concluded that communal land tenure institutions were flexible and not an immediate constraint on increasing agricultural production. The token priority given to research on land tenure over the past 20 years was justified in our judgment in light of the large amount of idle land available in almost all countries. But the view that land tenure problems are not a constraint on production is outdated. Land tenure and land use policy issues will be of strategic importance in the 1980s and 1990s as the frontier phase is exhausted and the intensification of agriculture proceeds.

We recommend that research on land use and land tenure receive greatly increased attention in the 1980s because of growing land/population pressure, the emergence of land markets, questions of access to land for the landless and small farmers in newly independent countries such as Zimbabwe, the development of river basins such as the OMVS in Senegal, Mauritania, and Mali, tenure issues involved in irrigation schemes (A.

[1/] For a discussion of inheritance and women's labor in Africa, see Jack Goody and Joan Buckley (1973).

Adams, 1977b), and the movement from nomadic to sedentary livestock production systems. Instead of pursuing studies of land use and land tenure as independent studies, however, we recommend that land tenure and land use be examined as integral parts of multi-disciplinary research on river basins, irrigation and livestock schemes. The research program of the Bureau of Resource Assessment and Land Use Planning (BRALUP) at the University of Dar es Salaam can serve as a model for this type of research. The University of Khartoum's recently established Institute of Environmental Studies is another example of an institution that is getting geared up to pursue research on land intensification, erosion, and degradation of the environment. For an authoritative survey of land tenure in Africa, see J. M. Cohen (1980b). Additional references include: Biebuyck (1963); Bohannan (1963); Chambers (1969, 1970); Parsons (1971); Harbeson (1973); Hoben (1973); Uchendu (1967); T. J. Anderson (1976); Faye and Niang (1977); CILSS/Club du Sahel (1978b); Higgs (1978); and Riddell, Parsons, and Kanel (1978).

Labor Use

Micro-economic research on labor utilization has focused on the organization of work on family farms, including the number of hours worked by members of rural households and the seasonal pattern of labor use. When evaluating the number of hours worked, it has been common procedure to classify labor inputs by sex, age, and season. Many researchers have also differentiated between labor from family members and hired labor. Comparisons of the number of hours worked by members of rural households by sex, age, and seasons have provided a relative measure of utilization or underutilization of labor by region, ecological zone, and farming system.[1/] Few studies have provided insights into the adjustment in labor use resulting from the introduction of cash crops and new technologies.[2/]

Farm level surveys throughout sub-Saharan Africa have consistently shown that farmers have low annual labor inputs in agricultural production by international standards. Cleave (1974) reviewed 50 micro-level studies in countries of both high and low man-land ratios and found that male adults were working an average of 1,000 hours per year in agricultural production as compared with 2,500 to 3,000 hours per year in Egypt and many

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[1/] Conventional measures of labor utilization, such as labor force participation, have not been widely used in analyzing rural labor markets in Africa because (1) most rural people are self-employed in producing largely for home consumption, (2) almost all the adult rural population participate in the labor force at some time of the year, and (3) at any given time, a negligible proportion of the rural labor force is unemployed and seeking work (Byerlee and Eicher, 1974).

[2/] The dynamics of the organization of work on family farms, has been a major topic of interest to French researchers working in Africa (Kohler, 1971; Copans et al., 1972; Rocheteau, 1975).

Asian countries. Some researchers have reported even fewer hours spent on farming activities, as low as 500 to 600 hours per year (Haswell, 1953; Norman, 1972). Farmers in humid areas often work more hours in farming--1,400 to 1,500 hours per year--than those in semi-arid areas (Byerlee, 1980). Also, labor inputs tend to be lower in permanent cultivation farming systems than in systems relying on bush fallow rotation due to reduced requirements for land clearing and preparation. Ruthenberg (1980) points out that perennial crops tend to require higher labor inputs per hectare than rainfed annual crops.

The number of hours worked per day, month, and year have all been found to differ significantly among African farming systems. Many researchers have reported that farmers work from around 4.5 to 7 hours a day, or about half of the daylight hours (e.g., Massell and Johnson, 1968; Haswell, 1953). In general, the hours worked per year in farming tend to be lower in arid regions because of the short growing season. The length of the working day has been shown to be affected by the time of the year, sex of the laborer, the crop, and the cropping operation (Cleave, 1974; Farrington, 1975b). The number of hours worked per month can reach as high as 200 to 250 hours during peak seasons but in many areas farming activities stop completely during the dry season. The number of days worked per year in farming by adults has generally been found to vary between 150 and 250 days (Cleave, 1974).

The sexual division of labor has received much attention, both in terms of total hours contributed to farming activities and the extent of specialization in labor use by sex. In general, women have been found to work fewer hours than men on farming activities. In Sierra Leone, for example, women worked about 900 hours per year in farming compared to men who worked an average of 1,450 hours per year (Spencer, 1976; Byerlee et al., 1977). Because many farm management surveys exclude domestic duties performed by women which average at least two hours per day, the scope for increasing labor inputs in farming by women has often been overestimated (Cleave, 1974). Moreover, even though men often have been found to work longer hours per day, month, and year in farming than women, this should not be regarded as a general rule since in many societies women devote more time to farming than men (Haswell, 1953; Massell and Johnson, 1968). Shapiro (1978) found in his study of 70 cotton growing farmers in northwest Tanzania that women worked 28 percent more hours per year than men in farming, off-farm, and domestic activities. But in the Moslem area in northern Nigeria, women contributed less than 5 percent of the total hours worked per year in farming (Luning, 1967; Matlon, 1979). In nearly every study reviewed by Cleave (1974), there was some sexual division of labor by crops grown and tillage activities performed. In many areas, women grow crops for household consumption while men grow crops for sale. Even where women are primarily responsible for a field, men commonly carry out the heavy tasks such as clearing and

preparing the field. Women, on the other hand, will often weed and harvest fields controlled by men. The individual control of fields and implications for household labor use has been examined by Kleene (1976), Rocheteau (1975), and Niang (1980).

At first glance, the figures on the annual hours worked imply that there is a substantial pool of surplus labor in rural areas. But micro-economic research has identified three important factors which largely account for the relatively low annual hours worked in farming during the year: (1) seasonality of labor demand, (2) non-farm competition for farm labor, and (3) failure to account for invisible labor inputs such as walking to and from fields.

After more than 20 years of farm level research, there is now overwhelming evidence that seasonal labor is a constraint on the expansion of production with hand hoe technologies (de Wilde et al., 1967; Luning, 1967; Cleave, 1974; Collinson, 1972; Spencer and Byerlee, 1976; Singh, 1976; Shapiro, 1978; Purdue University, 1980). Cleave (1974) presented several examples in which the availability of family labor during peak agricultural seasons was identified as a crucial factor determining the level of farm output and income. Spencer and Byerlee (1976) evaluated the magnitude of the seasonal variation in labor inputs in Sierra Leone by computing coefficients of variation of monthly labor inputs in farming by micro-climates; the coefficient of variation for male labor inputs was above .50 in the northern region and less than .25 in the southern regions receiving more rainfall. Norman, Pryor, and Gibbs (1979) reported that nearly 60 percent of farm labor inputs in their survey in northern Nigeria were concentrated in the four-month peak season. In a recent study of millet and sorghum farmers in Upper Volta, Richard Swanson, an anthropologist, reports that "the days immediately following the first rains are characterized by an average of over 8-10 hours planting per day per man-unit. The reason planting drops off 3-5 days after the first big rains is because the soils have already become too dry for proper germination and establishment of seedlings" (1981, p. 35).

Heyer (1971) and Norman (1972) show that the shadow price of labor during peak seasons is at least four times higher than the prevailing wage rate. Several production function analyses have shown that the MVP of labor is large and significant during peak season activities. Moreover, most regressions of the amount of land cultivated show that the number of hours worked in peak season activities can explain most of the variation in output. In general, seasonal labor peaks tend to be more acute in systems of permanent cultivation than in fallow systems, except in cases where irrigation enables crops to be grown in the dry season (Ruthenberg, 1980).

Non-farm activity is now recognized as a major use of rural labor. Pudsey (1967), and his colleagues in Uganda, were among the first to document the large amount of time spent on non-farm activities. There is some evidence that as much as 50 percent of

working time in some seasons of the year may be spent in rural non-farm activities (Cleave, 1974). Hoben (1973) reported that in Ethiopia, court hearings, funerals, and other social and religious ceremonies are very time-consuming for rural people. Elliott et al. (1970) provided evidence that males other than the head of household spend as much as four to five times as many hours on non-farm activities as they do in farming.

There is evidence that even at times of maximum use of family labor in farming up to three to four hours a day per adult may be spent on non-farm activities (Liedholm and Chuta, 1976). Norman (1972), for example, found that farmers spent 31 percent of their working time in off-farm employment during the peak month of farming activities.[1/] Norman speculated that because some activities such as trading need to be maintained on a year-round basis the farmers might forego higher short-term earnings in agriculture during peak seasons because they can earn higher annual returns by allocating a portion of their labor throughout the year to trading and other non-farm activities. Hunter (1967), Zalla et al. (1981), and others have shown that some farmers are forced to work off the farm when they encounter a cash and food shortage during the hungry season and do not have access to credit to buy enough food to last until harvest time.

Finally, the failure of researchers to include time spent going to and from fields and markets has made it appear that farmers spend less time on farming-related activities than they actually do. Time spent walking to and from fields can account for as much as 20 to 25 percent of the hours worked in farming during the day. The underrepresentation introduced by not including walking time to fields is not as severe in East and Central Africa where in most places there is a dispersed settlement pattern. But in East Africa, the time spent going to markets may be substantial.

Supply of Labor

Although it is well documented that the availability of labor during peak agricultural seasons is a key determinant of the area planted and the level of agricultural output in Africa, substantially less research has been conducted on factors determining the supply and productivity of labor (health, nutrition, education, family size) than on the demand for labor. In general, the agricultural labor supply is determined by the potential stock of labor (family and non-family) and the length of time each individual generally works, expected returns to labor and the opportunity cost of an agricultural task if non-farm jobs are available, and the physical health and nutritional level of a laborer.

The size of the rural household clearly is the key determinant of the potential stock of labor for agricultural activities. For example, farmers with two or more wives and

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[1/] Moreover, Norman did not include activities such as gathering, grass cutting, and firewood collection in calculating total time worked.

several children consistently have a larger area of land under cultivation than farmers with one wife. The supply of labor for particular activities is, however, affected by the fact that many agricultural tasks are traditionally considered to be age- and sex-specific. In East Africa, women are heavily involved in food production, while in West Africa women play an important role in food crop production and processing, trading, weaving, and other non-farm activities. While children from 10 to 15 years of age are an important source of farm labor in many parts of Africa, they generally work fewer hours than adults and tend to specialize in tasks such as tending livestock, wood gathering, and bird scaring. Although most surveys have found that well-defined sex roles affect the potential labor supply, there is growing evidence that sex roles are not a major constraint on agricultural production. Women and children, for example, have been found to increase their labor inputs several-fold during peak seasons to help overcome seasonal labor bottlenecks. Also, there is growing evidence that sex roles do change over time (Young, 1977). But cultural factors influence the supply of agricultural labor in other ways than through sex- and age-specific roles (Mbithi, 1977). For example, Reyna's study of the Barma of Chad illustrated how marriage payments can delay the age of marriage of males, having an important effect on the supply of male labor. Copans et al. (1972) have described the relationship between religious obligations and work patterns among the Mouride in Senegal.

Hired labor has historically played a minor role in increasing the supply of labor on African farms and in alleviating seasonal labor bottlenecks. Since there are relatively few landless laborers in most countries in sub-Saharan Africa, hired labor must be provided by other farmers or migrants from other areas. Migration within ecological areas is limited, however, because small farms will often reach their peak demand for labor at about the same time as larger farmers desire to hire labor to overcome seasonal bottlenecks. As a result, farmers in sub-Saharan Africa generally purchase less hired labor than in other regions of the third world. Norman (1972), Spencer and Byerlee (1976), and Byerlee (1980) have shown that the percentage of labor inputs supplied by hired labor is usually below 20 percent on small farms. But one should not accept the seasonal labor bottleneck as given because the supply of labor can change dramatically in a short period of time when there are opportunities and incentives. For example, the dramatic increase in wage rates in Nigeria in the late seventies has induced a large volume of migration from northern Cameroon to northern Nigeria.

One of the major constraints on the supply of labor to agricultural activities is the possibility of engaging in non-farm activities which usually yield higher returns to labor. Because the returns to agricultural labor in sub-Saharan Africa are often only $.10 to $.50

an hour, the value of leisure or other non-farm activities does not have to be very high before labor is diverted from agriculture. In one of the few formal tests of the hypothesis that relative returns to alternative employment opportunities determine the allocation of labor between farm and non-farm activities, Minford and Ohs (1976) used multiple regression analysis to evaluate determinants of the supply of agricultural labor in Malawi. Based on time series data from 1948 to 1968, they found a significant (.05) relationship between the returns to non-farm employment opportunities and the amount of labor used in farming.

Physical health and the nutritional level of rural people may have a major impact on the potential supply of labor but the impact of sickness on labor productivity must be considered unresolved. With the exception of C. M. Elliott's (1970) study in Zambia and Brooks, Latham, and Crompton's (1979) pilot study in Kenya, there has been little research on the impact of health, nutrition, temperature, and humidity on labor productivity. In many countries, there is a noticeable "hunger" (soudure) period before harvest and a significant reduction in caloric intake during this period. Although improved transportation and emergency food programs have reduced the spectre of famine, one cannot ignore the facts that in the short run labor supply will be inelastic and labor productivity will be low during the hungry season because of the inability of some families to get enough calories either through their own food stocks or through off-farm employment.

H. Brandt's (1979) study of peasant work capacity in Africa was designed to test the hypothesis that there is an upper limit to labor inputs in agriculture which is determined by climate, health, and nutritional status. Although the hypothesis could not be directly tested because data were not available, Brandt argues that an annual labor input of 1,100 to 1,200 hours per year in farming represents an upper limit for many farmers unless new production techniques are introduced and/or improvements are forthcoming in the health and nutrition of the workers. More research is clearly required on the significance of health, nutrition, and disease on agricultural output. For an assessment of the interrelationships between disease and development, see Hughes and Hunter (1972) and Hunter (1981); and for an overview of human nutrition in sub-Saharan Africa, see Latham (1980).

The relationship between education and agricultural change has surprisingly received little attention by researchers in sub-Saharan Africa relative to Asia and Latin America. A recent survey by John Hanson (1980) entitled "Is the School the Enemy of the Farm?" notes that the effect of schooling on the diffusion of agricultural innovations and agricultural change in Africa is hard to measure because of the lack of bench mark data and the interdependent nature of variables such as education, health, age, and access to credit. But Hanson concludes that, on balance, the primary school is a positive force in

improving the lives of rural people. One of the few rigorous studies of the effect of schooling on male and female farm managers is Peter R. Moock's (1976) study in western Kenya.[1/] Moock found that the impact of the number of years of schooling on maize output was greater for female than male headed farm households, and that women do not seem to benefit as the men do from extension contact, perhaps due to the almost all male extension system as of 1976. In a more recent study, Moock (1981) evaluated the effect of education on the efficiency of input use by a sample of 101 male farmers in western Kenya. Moock found that a farmer who completed four or more years of school can be expected to obtain higher maize yields than farmers without formal education but that extension contact appears to substitute for formal education in the acquisition of knowledge relevant to maize production.

In summary, micro studies indicate that there is an active and flexible rural labor market for men, women, and children; seasonal changes in wage rates reflect the changing demand for labor; there is no evidence of disguised unemployment; and that the marginal product of labor in agriculture is low but positive in sub-Saharan Africa. Major problems which need to be addressed by researchers in the 1980s are: what are the causes of low productivity of labor in agriculture, what steps can be taken to generate more jobs in rural areas especially during the long, dry season, and how can seasonal labor bottlenecks be solved through capital/labor substitution, agronomic research which produces varieties and packages with different planting and harvesting dates, and rural-to-rural migration.

Allocative Efficiency

In his seminal book, Transforming Traditional Agriculture, Schultz (1964) contended that in "traditional agriculture,"[2/] farmers producing with "age-old techniques" are generally efficient in the use of their resources even if they are poor. But Schultz presented no empirical evidence from Africa. He drew on village studies in India and Guatemala to support his model. There have been several attempts in Africa to test the allocative efficiency hypothesis by using a simple test of whether the MVP of an input derived from a value productivity function for the entire farm is different from its MFC as represented by the market price for that input. Only a few studies have evaluated farmer efficiency by comparing the MVP of each input in different uses. In general, farmers in Africa have been found to be efficient in the use of their present resources. Specifically, empirical studies have shown that the null hypothesis that farmers allocate

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[1/] In this area, about one-third of the farm households are headed by women because the men are living in cities.

[2/] Traditional agriculture is defined as a farming system where no new factors have been introduced in a long time.

resources so that the MVP of inputs equals their MFC has not been rejected (Welsch, 1965; Luning, 1967; Upton, 1967; Massell and Johnson, 1968; Norman, 1972; Shapiro, 1973; Norman, Fine et al., 1976; Norman, Beeden et al., 1976a, 1976b). The finding that small farmers are efficient but poor has important policy implications because it indicates that additional agricultural output must come through technical change and not through a reallocation of resources.

Several researchers have expressed severe reservations about the above method to evaluate farmer efficiency and the validity of the conclusions drawn on the basis of those methods. Luning (1967), for example, contended that the MVP of an input should not be expected to equal its MFC in any empirical test using survey data since (1) the estimated average production function actually reflects a hybrid of several production functions, and (2) the regression coefficients usually have large standard errors, making it unlikely that a t-test will indicate that the MVP and the MFC of an input will be shown to be significantly different. In their research on the efficiency of Zimbabwean farmers, Massell and Johnson argued that efficient resource allocation on average is a necessary but not a sufficient condition for efficiency on individual farms. As a result, there may be considerable scope to improve resource allocation on individual farms regardless of findings relative to an entire sample of farmers.

Shapiro has challenged the widely accepted notion that empirical evidence overwhelmingly supports the efficient but poor hypothesis. Shapiro (1973) argued that failure to control Type II errors in tests of allocative efficiency has led to unjustified acceptance of the conclusion that there are not significant differences between the MVP and MFC of inputs. He demonstrated that many empirical tests of the efficient but poor hypothesis have not given as unambiguous results as have been reported.

Ruthenberg (1968) and Wolgin (1975) have pointed out, among others, that first-order conditions for profit maximization do not necessarily constitute an appropriate test of whether farmers are efficient resource allocators. Ruthenberg argued that even though farmers in Tanzania appeared to be using too much labor and too little land, their resource allocation pattern could be explained by (1) constraints on access to land for high return cash crops, and (2) by a "heritage of traditional behavior" favoring subsistence production. Wolgin (1975) analytically showed that if farmers are risk averse it should not be expected that they would equate the MVP to the MFC, nor would the MVPs of an input be equated in all uses. He argues that two appropriate tests for maximizing expected utility are (1) the ratio of the MVPs of each pair of inputs should be equal in all uses, and (2) rank of the MVPs of an input in different uses should be the same as the rank of the

marginal contribution to risk of each use.[1/] In an empirical test of his risk averse hypothesis using a sample of Kenyan farmers, Wolgin found that in 86 percent of the cases evaluated, the ratio of MVPs of two inputs in different uses was equal. Regarding his second test, Wolgin found that in 87 percent of the cases, the ranking of crops on the basis of the MVPs of inputs was the same as their ranking in terms of increment to risk.[2/]

Several studies reveal that efficiency issues must be evaluated on a more disaggregated basis than a simple comparison of an average MVP of an input with its MFC throughout the year. For example, Heyer's LP model showed that the shadow price for early planting labor in Kenya was nearly four times the prevailing wage rate for hired labor and that shadow prices for medium planting and early weeding labor were around twice the wage rate. Norman (1972) found that the shadow price of peak season labor was around four times the local wage rate in northern Nigeria.

The use of an average production function over a sample of farms is questionable in light of evidence that (1) when crop-specific production functions can be estimated, the MVP of inputs used on different crops is generally different (Massell and Johnson; Tench, 1975; Wolgin, 1975); (2) production functions for different villages are generally different and therefore tests of efficiency should not be based on a pooled sample of farmers from many villages (Massell and Johnson, 1968; Ruthenberg, 1968; Tench, 1975); and (3) assessments of relative technical efficiency among farmers indicate that farmers are often not producing on the same production surface (Shapiro, 1973; Mijindadi, 1980).

The few attempts in sub-Saharan Africa to estimate the potential gains from reallocation of resources have shown that the potential increase in farm income from equating the MVP of all inputs in all uses would generally be under 10 percent (Massell and Johnson; Shapiro, 1973). On the other hand, there is some evidence that the potential gain could be substantial if all farmers could operate on the production function of the most "technically efficient" farmers (Shapiro, 1973; Mijindadi, 1980). But structural problems such as limited access to high quality land, inability to carry out cropping operations when desired because cash requirements force low-income farmers to sell their labor to other farmers during peak farming seasons, and market imperfections are largely responsible for the lower productivity achieved by most farmers. It is therefore unlikely that deviations from a frontier production function will ever be eliminated.

[1/] In other words, if the MVP of labor is higher in crop A than in crop B, then crop A should be more risky than crop B. This finding is consistent with portfolio theory.

[2/] D. L. Young (1979) pointed out that Wolgin made a mathematical error in the derivation of his model and discussed the implications of the error for Wolgin's empirical analysis. Wolgin (1979) acknowledged the error but contended his empirical findings are not changed by the correction made by Young.

The main implications of studies of allocative efficiency for researchers are that future production function studies should (1) be based on disaggregated data, taking into account at a minimum the differences among villages and among crops; (2) give increased attention to the analysis of efficiency under uncertainty; and (3) consider the divergence between purchase and sale prices of outputs and the acquisition and salvage prices of inputs.

The conclusion for policy makers is that although there might be scope for individual farmers to increase their output through the re-allocation of their resources, technical change is vital for increasing aggregate farm output.

Returns to Land and Labor

During the 1960s and early 1970s, many researchers generated data on the returns to land because of the difficulty of collecting labor data throughout the entire agricultural year. More recently, researchers have emphasized comparing returns to labor from different crops or across types of farming systems. In surveys where detailed labor data have not been collected, some researchers have estimated returns per man-day or returns per hour by assuming a standard work day of six to eight hours (Ruthenberg, 1980).

One of the first comparative studies of returns to land and labor for different types of farming systems in Africa was Ruthenberg's (1968) collection of ten case studies in Tanzania.[1/] The case studies showed that: (1) the highest average returns to land were realized by tobacco-maize farmers followed by rice-sugar cane farms; (2) farms under permanent cultivation, usually based on bananas, consistently had a higher return to land than did farming systems based on semi-permanent cultivation of cotton, millet, or maize; and (3) returns per worker were highest on tobacco-maize farms, followed by banana-coffee farms and then by farmers relying on cotton-millet-maize.

The most comprehensive summary of returns to land and labor in different enterprises and farming systems in sub-Saharan Africa is found in Ruthenberg's collection of representative farm and enterprise budgets in Farming Systems in the Tropics (1980). Ruthenberg selected data from more than 40 surveys covering 19 sub-Saharan African countries. Ruthenberg's findings about returns to land and labor in farming systems defined according to the intensity of rotation are as follows:

[1/] Ruthenberg designed and supervised the studies so the same format was used in deriving gross returns per farm and per acre, production expenditures and net returns per acre, and per man equivalent in each case study. Unfortunately, costs of production were not specified, labor was measured as a stock, and yield estimates were sometimes taken from experiment stations rather than from the sampled farmers.

(1) output per man equivalent is likely to decrease but returns per man-hour are usually higher with increasing permanency of cropping;

(2) returns per hour and per acre are more variable in bush fallow cultivation systems than in shifting cultivation systems;

(3) returns to land are often higher in permanent cultivation systems than in rotation systems but returns to labor are generally lower; and

(4) marginal returns to labor tend to be lower in permanent cultivation systems than in fallow systems since no unused land is available to productively absorb additional labor.

In terms of different cropping enterprises, Ruthenberg found:

(1) the returns to land and labor were generally higher and more stable from perennial crops than for annual crops;

(2) several crops with high labor requirements such as sugarcane have higher returns per acre but lower returns per hour than staple food crops such as maize or sorghum;

(3) crops such as manioc and sweet potatoes tend to have high yields of low quality calories while crops such as millet, sorghum, and maize have lower yields (in terms of calories) but better quality calories; and

(4) in forest zones, bananas and plaintains return more calories per unit of land with less labor than do root crops.

Some of the most comprehensive data on returns to labor in farming and non-farming activities for any country in sub-Saharan Africa are available from a 1973-74 national survey in Sierra Leone which was carried out under the direction of Dunstan Spencer. The major findings reported in Spencer and Byerlee (1976) and Spencer, Byerlee, and Franzel (1979) were:

(1) In general, the lowest returns were received for annual food crops but the returns to rice varied widely among the five dominant rice production systems.

(2) The returns per man-hour for tree crops were generally from two to four times those for annual crops.

(3) For some cropping enterprises such as onions, peppers, and tomatoes, the returns to land were high but the returns to labor were relatively low because of high labor inputs.

(4) Cassava had relatively low returns to land but because of low labor requirements the returns to labor were higher than annual crops such as groundnuts.

(5) Cocoa had around the same return to land as did coffee but much higher returns to labor because of its lower labor requirements.

(6) Non-farm enterprises generally had higher returns to labor than did either annual or perennial crops.

In the semi-humid and forest zones in Nigeria, Robinson (1974) found that (1) returns to labor from tree crops such as cocoa and oil palm were around two to three times higher than those for annual crops, including rice, maize, and cowpeas and (2) the returns to labor from yams and cassava were slightly higher than those for most cereal crops. Olayemi (1974) showed that the net returns per acre were generally similar for rice, cocoyams, yams, and cocoa in western Nigeria.

Several estimates of returns to land and labor are available for the semi-arid region of West Africa. Matlon (1979) and Norman, Pryor, and Gibbs (1979) demonstrated that returns per acre and per hour were higher for crops grown in mixtures than sole stands. On the basis of a survey of 480 farms in the Eastern Region of Upper Volta, Lassiter (1981) found that the returns to rice per acre were around 150 percent higher than those for maize, the crop with the second highest returns. Returns per acre for sorghum and millet were around one-third of those for rice even though sorghum and millet accounted for 80 percent of the area cultivated. Both cotton and groundnuts, the traditional cash crops in the area, had very low returns per acre.

Information on returns to labor and land for rice can be found in Winch (1976), Fotzo and Winch (1978), and Lang (1979). Fotzo and Winch (1978) examined rice production systems in northwest Cameroon and found that the returns to labor were higher in the traditional system after government subsidies had been removed from mechanized systems. Lang compared the returns to land and labor in several systems of rice production in West Africa and found a wide variation in the returns to upland rice; the return per man-day was nearly nine times higher in parts of western Nigeria than in northern Sierra Leone.

Land Intensification

Land use patterns in sub-Saharan Africa have changed dramatically over the past 20 years. Shifting cultivation systems have largely given way to semi-permanent and permanent cultivation systems and a general intensification of farming. Numerous factors have stimulated land intensification, including (1) increasing population pressure, (2) growth of rural and urban purchasing power, (3) government policies and programs such as settlement schemes, (4) changing price relationships among crops, particularly the relative prices of export crops and food crops, and (5) improved production technologies (Netting, 1974; Ruthenberg, 1980). Growing population pressure has been widely acknowledged to be the most important explanation of agricultural intensification.[1/] While some countries in sub-Saharan Africa still have substantial amounts of idle land in reserve, there are large variations between and within countries. Several countries have reached and exceeded the point where the traditional land-extensive systems are able to provide the food requirements of the local population and maintain environmental stability (Hunter and Ntiri, 1978).

Historically, land intensification has taken place in isolated pockets of high population density. Studies by Netting (1968) of the Kofyar in Nigeria and Boulet (1975) in

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[1/] Although dependency theorists such as Amin argue that rapid population growth is merely a symptom of the transition to the social formation of peripheral capitalism.

the Mandara Mountains, Cameroon, reveal that hill and mountain people can survive on a poor natural resource base. The two most important adjustments noted were to (1) increase the use of animal manure, and (2) develop concentric cropping zones in which nearby fields are worked intensively and are heavily manured while more distant fields receive little attention. Concentric land use patterns have also been noted in heavily populated plains such as the peanut basin in Senegal and in parts of Nigeria (Goddard, 1972; Lagemann, 1977; Ruthenberg, 1980). One of the most dramatic examples of response to land shortage is the case of the Wakara who have lived for more than a century on a small island in Lake Victoria (Ruthenberg, 1980).

Due to unprecedented rates of population growth throughout sub-Saharan Africa, land intensification is no longer being viewed as an isolated and exceptional event. For example, public policy has quickly shifted to land intensification in countries such as Rwanda where neo-Malthusian problems are reality, not myth, in Senegal and in Kenya where a 4.0 percent projected rate of growth of population will likely double the size of the population (from 14 to 28 million) in 20 years (Shah and Willekens, 1978; Toksoz, 1981).

The link between population growth, land use, and the structure of agricultural production has been the subject of numerous studies, particularly by researchers in Francophone Africa (e.g., Tourte, 1974; Delpechi and Gastellu, 1974; Marchal, 1977; ORSTOM, 1979). Research shows that intensification is accompanied by a reduction in the length of fallow and farm size and an increase in labor inputs per unit of land. For example, Faye and Niang (1977) and Hunter and Ntiri (1978) found that the major difference between sparsely settled and high density settlement areas is that farms in any given village area tend to become smaller and fields controlled by households become more widely scattered as density increases. M. J. Mortimore (1967) observed that the following changes were associated with increasing population density in the Kano close-settled zone in northern Nigeria: (1) disappearance of fallow and more individualized tenure, (2) rising value of marketed land, (3) increasing fragmentation, (4) more use of fertilizer, and (5) an increase in off-farm employment.

Various ethnic groups have shown a remarkable ability to adapt to growing population pressure. Faulkingham and Thorbahn (1975) conducted field research in Tudu, a large village in south central Niger in 1974-75 and concluded that the local population has adapted their system of consumption and production to maximize the chance of survival in the face of periodic environmental degradation. Nukunya's (1975) case study in southeastern Ghana shows that local farmers have become relatively wealthy despite high population density and poor soil because they have modified their agricultural production technologies to the requirements of the area. Villages have often been able to adjust to

increasing pressure on land by seasonal migration and the formation of sub-villages (Faulkingham, 1977).

Although the evidence is overwhelming that African farmers have adjusted their cultivation techniques in the face of reduced fallow and falling yields, there is considerable controversy over the ability of food production to keep up with population growth in the 1980s and 1990s. The center of the controversy is the Boserup (1965) hypothesis that population growth is a major factor stimulating the adoption of improved agricultural practices. Although Boserup's model has been generally rejected as a model of agricultural development,[1/] some support for the Boserup hypothesis is reported by Datoo (1973) in his study of 216 households in a mountain region of Tanzania. Datoo found that farmers in high density areas were using significantly more improved production techniques than those in areas of medium and low density. Moreover, Ruthenberg (1980) found that in areas characterized by high population density there was a tendency toward (1) increased use of high yielding varieties which produce a greater proportion of edible dry-matter content; (2) reliance on crops which result in higher output with higher inputs--such as shifting from millet to maize and from grains to root crops; and (3) increasing the length of the growing season through multiple cropping.

Lagemann's (1977) study in eastern Nigeria presents some of the rare quantitative data on the impact of increasing population density on land use and soil fertility. Lagemann studied three villages in high population density areas of eastern Nigeria and found that physical measures of soil fertility--organic carbon and nitrogen--declined as population density increased and the length of fallow was reduced. More dramatic was the reduction of crop yields as the years in fallow declined. Cassava yields fell dramatically from 10.8 tons to 2.0 tons per hectare as the length of fallow was reduced from 5.3 to 1.4 years. Moreover, the length of fallow was found to explain 60 percent of the variation in cassava yields. In addition to a reduction in soil fertility, there was an increase in soil erosion, acidity, and weeds as the length of fallow was reduced. Although Lagemann found many examples of farmers introducing changes in farming practices as population pressure increased--i.e., intensification of production on compound fields, using mulch, and increasing dependence on off-farm employment for income generation--the evidence is clear that population pressure was running far ahead of technical change in the three villages studied by Lagemann in eastern Nigeria.

[1/] Population growth by itself cannot be taken seriously as a model of agricultural change in the short run because of the recorded cases in history where people have starved (Irish famine, Bengal famine, 1943) and where the number of landless has increased before innovation was forthcoming. Boserup (1981) has recently analyzed long-term trends in population growth and technological change.

V. TECHNICAL CHANGE

Technical scientists in sub-Saharan Africa have focused on helping farmers through (1) research on improved varieties and agronomic practices, including spacing, timing of planting, weeding, and the application of fertilizer, herbicides, and pesticides; and (2) research on mechanical technology, including hand tools, animal traction, and tractor mechanization. Most agronomic research has been carried out on experiment stations and has focused on increasing yields, yield stability, and insect and disease resistance. Research on animal traction, tractor mechanization, and selective mechanization of particular tasks has been dominated by two groups of researchers over the past 25 years: engineers and economists. The engineers have concentrated on how mechanization influences variables such as yields, acreage, timeliness, and cropping intensity (see Kline, Green et al., 1969; Giles, 1975). Economists have focused on the financial and economic profitability of alternative types of mechanization and more recently on the employment and income distribution consequences of mechanization (Gemmill and Eicher, 1973; Binswanger, 1978).

Although research on plant breeding, agronomic practices, and mechanization has been extensive, African agriculture is less mechanized and has been less affected by new technologies than other areas of the world. There has been a long history of research recommendations being rejected by farmers and endless debates about the need to reorganize national research systems. Interest in why technologies were or were not being adopted stimulated social science research on the diffusion of innovations beginning in the 1960s. Since the mid-1970s, there has been growing interest in irrigation and in farming systems research to complement commodity research programs. The following topics are reviewed in this part: evolution of approaches to technical research; agronomic research, irrigation; mechanization; agricultural extension; and farming systems research (FSR).

Historical Perspective

As a broad generalization, from the beginning of the colonial period in the 1880s until the 1920s and 1930s, agricultural growth was based on exploiting Africa's natural resources and unskilled labor (Eicher, 1967). Since the 1920s, there have been five major turning points or shifts in research strategies in sub-Saharan Africa. These turning points all represent attempts to move from a natural resource base to a science-based strategy of agricultural research and development.[1/]

[1/] The history of agricultural research is documented by McKelvey (1965) and Yudelman (1975). The status of agricultural research in the late 1960s is reviewed in the proceedings of the Abidjan Conference on Agricultural Research Priorities (National Research Council, 1968). For the 1970 period, see National Research Council (1974, 1978).

The first turning point occurred in the 1920s when national research stations were established in several of the then colonial territories of Africa. Agricultural research stations established during this period, such as the Institute of Agricultural Research (IAR) in Nigeria, have continued to play a leading role in varietal and agronomic research through each of the subsequent turning points in African agricultural research strategies. During the colonial period, the focus of agricultural research was on expanding the production of export crops such as cotton, groundnuts, oil palm, and cocoa.[1/] Colonial governments established global research networks in order to increase the productivity of research on export crops. For example, a global cotton research network--the Empire Cotton Growing Corporation--was launched in British colonies in 1921. Anthony et al. point out that "This organization was able to recruit agricultural scientists of high caliber by offering career opportunities that were not dependent on the research programs within a single colony. Cotton research teams were assigned by the Corporation to experiment stations in Kenya, Malawi, Nigeria, Sudan, Swaziland, Tanzania, Uganda, and Zambia" (1979, p. 252). The country research teams were linked to the Imperial Research Institute in Trinidad. The French also established a number of global research networks beginning in 1921, followed by a Belgian network for their colonies--Belgian Congo (now Zaire), Rwanda, and Burundi. These global research networks were a forerunner to the International Agricultural Research Centers (IARCs) beginning with IRRI in the Philippines in 1960.

The second turning point came in the 1950s with the introduction of regional research stations serving several countries in a common ecological zone. For example, the British established a system of specialized research institutes for its four English-speaking colonies in West Africa. These included the West African Institute for Social and Economic Research (WAISER) in Ibadan; the West African Rice Research Station in Sierra Leone; the West African Cocoa Research Institute in Ghana; and the West African Oil Palm Research Institute in Nigeria (Eicher, 1970).

The performance of the global and regional research institutes in Africa over the 1920-1960 period was mixed, partially because many did not have a critical mass of scientific talent, a few were placed in poor locations, and harsh taxation policies in some countries dampened economic incentives to adopt new technology. But some research institutes were highly productive such as the oil palm research institutes which were set up in the Belgian Congo in 1926, in Nigeria in 1939, and in three French-speaking colonies in West Africa beginning in 1947. These institutes were linked with oil palm institutes in

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[1/] Colonial governments invested few resources in food crop research because it was assumed that surplus land would automatically be brought under cultivation by subsistence farmers in line with population growth.

Malaysia. Priority in the oil palm research network was directed to crossing African and Asian oil palms to produce highly productive hybrid oil palm varieties. Hybrid oil palms were introduced on plantations and small farms in Nigeria in the early 1960s. Although the Nigerian hybrid oil palm varieties outyielded "wild" oil palms by about 700 percent, G. L. Johnson (1968) pointed out that this genetic breakthrough was held back from rapid adoption by the harsh taxes of the Nigerian Oil Palm Marketing Board in the 1960s which extracted one-third to one-half of potential smallholder revenue from oil palm produce.

The third turning point in agricultural research came in the postindependence era of the early 1960s when many of the regional institutes were nationalized. During this period, some of the regional research institutes were allowed to atrophy (e.g., the West African Rice Research Institute in Sierra Leone), while the others were incorporated into national research systems. For example, the West African Cocoa Research Institute in Ghana became the Cocoa Research Institute of Ghana, while Nigeria converted the West African Oil Palm Research into the Nigerian Institute for Oil Palm Research. In the mid-1970s, the well-established East African Agricultural Research Organization with sub-stations in Kenya, Uganda, and Tanzania was allowed to languish and finally dissolve with the breakup of the East African Community in 1978.

The fourth turning point came in the mid-1960s with decisions to reactivate the colonial concept of a regional institute to serve a region such as West Africa. The former West African Rice Research Institute with its headquarters in Sierra Leone was reactivated in 1970 as the West African Rice Development Association (WARDA) and its headquarters was moved to Monrovia. The mission of WARDA is to assist its 15 member countries in carrying out socio-economic studies and variety, herbicide, insecticide, and fertilizer trials in cooperation with scientists in member countries. WARDA has a dedicated staff and strong political support within West Africa. A second major decision in the 1960s was to establish several International Agriculture Research Centers in Africa. The International Institute of Tropical Agriculture (IITA) was established near Ibadan, Nigeria, in 1969, followed by the International Livestock Center for Africa (ILCA) in Ethiopia in 1973; the International Laboratory for Research on Animal Diseases (ILRAD) in Nairobi; and the International Center for Insect Physiology and Ecology (ICIPE) in Nairobi.

The fifth turning point came in the mid-1970s in response to the drought of the late 1960s and early 1970s and rising food imports. These problems brought forth crash programs to expand national and international research systems with emphasis on food crops. During this period, some of the French regional research systems (e.g., IRAT

stations) were converted into national research systems[1/] but IRAT continues to have one of the most active and diverse research programs of any technical research organization working in Africa. IRAT is doing research on sorghum, millet, maize, rice, tubers, and vegetables. ICRISAT started a cooperative program in Upper Volta in 1975, followed by a decision in 1981 to set up a major ICRISAT sub-center in Niamey, Niger, in order to serve Niger, Upper Volta, and Mali. CIMMYT is conducting research on wheat and maize in East Africa, maize in Ghana, and has two scientists posted at IITA in Ibadan.

This discussion of five turning points of agricultural research points out the gradual increase in the role of science and technical change in African agriculture. The sixth turning point will take place in the 1980s and 1990s with the closing of the frontier and the intensification of agricultural production through irrigation and a movement to double and triple cropping. The intensification phase will require large and unprecedented investments in agricultural research and training because research on a number of problem areas--for example, irrigation--was almost non-existent until the 1970s. Also, intensification increases insect and disease problems and can lead to micro-nutrient problems (due to slow mineralization).

A major lesson to be learned from the history of agricultural research in sub-Saharan Africa is that long-term (25- to 50-year) investments will be necessary to develop effective national agricultural research services. Idachaba's (1980a) evaluation of Nigeria's agricultural research system points up the amount of time that it will take to develop strong national research programs. Although Nigeria has greatly expanded its pool of scientists since independence in 1960, Idachaba reports that the vacancy rate among senior scientists in the eight major research stations in Nigeria averaged 40 percent in 1977/78 and the turnover rate of Nigerian scientists was extremely high. Francophone countries are generally behind anglophone countries in the Africanization of their national agricultural research systems. For example, in Senegal, the IADS reported (1979) that there were only 36 Sengalese researchers among the 99 agricultural researchers in the country and only 3 of the 99 were rural social scientists. It is obvious that agricultural training should be greatly stepped up in the 1980s and 1990s because the training industry in Africa is at least 20-25 years behind most Asian and Latin American countries.

Agronomic Research

The number of published technical reports on agronomic research is staggering relative to published economic studies. But it is difficult to evaluate technical research

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[1/] For example, the IRAT stations in Senegal became known as ISRA--Senegal Institute of Agricultural Research. In Niger, the IRAT station became known as INRAN--Nigerian Institute of Agricultural Research.

because much of it is highly location-specific and much of it has never been synthesized and put into farmer recommendations.[1/] As a result, when one asks a basic question such as should governments subsidize fertilizer for food crops, one is forced to go from experiment station to experiment station throughout Africa in order to review annual reports and assemble unpublished input/output data on fertilizer response in fertilizer trials. Attempts to synthesize agronomic research results can be found in Leakey (1970) and Acland (1971) for East Africa and Irvine (1969) and Kassam (1976) for West Africa. Leakey and Wills (1977) is a valuable reference for food crops. Important journals reporting results of agronomic research are Experimental Agriculture, Tropical Agriculture, Tropical Science, and L'Agronomie Tropicale.

This review of agronomic research covers: (1) crop improvement programs; (2) soil fertility and fertilizer; and (3) research on selected managerial practices.

Crop Improvement

Research on crop improvement forms the cornerstone of agronomic research programs. The main approaches are to identify, screen, test, and multiply better local varieties and promising new varieties from throughout the world, coupled with selective breeding for desired characteristics. Progress has been uneven by ecological zone and by crop. We will present an overview of crop improvement research for the major crops--sorghum, millet, maize, rice, wheat and triticale, cotton, groundnuts, cowpeas, cassava, and yams.

Sorghum and Millet

Research on sorghum and millet is of central importance in the semi-arid tropic (SAT) regions of Africa because these are the dominant staple foods.[2/] Millet and sorghum are often grown in mixtures. Millet and cowpea mixtures are common in low rainfall areas and millet and sorghum are often grown together in higher rainfall areas.

Local sorghum varieties throughout sub-Saharan Africa are generally photosensitive,[3/] long season (120 to 140 days), reasonably tolerant to striga,[4/] and are up to five meters in height. The photosensitive quality is desired because it enables local sorghums

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[1/] For an excellent overview of issues in translating agronomic research into farmer recommendations, see Perrin et al. (1976).

[2/] A valuable reference on sorghum is Doggett (1970).

[3/] Photosensitivity, day length sensitivity, and photoperiodic are synonymous terms to indicate that the biological development of a plant, and in particular flowering and seeding, are governed by the length of the day.

[4/] A weed which attaches itself to the roots of millet and sorghum and reduces plant growth and yields.

to escape head mold and provide grain of good quality even though planting may be spread over several weeks. Varieties with long stalks are favored by farmers since sorghum generally has multiple uses: grain for family consumption, while the stalk is used for housing and animal fodder during the dry season. But most long stalk, local varieties have low yield potential (Andrews, 1975; Arrivets, 1976) and day length sensitivity has restricted the adaptation of local varieties to different latitudes. Also, sorghum diseases are a major problem in Africa and throughout the world. For an excellent survey of sorghum diseases, see ICRISAT (1980b).

There have been active sorghum selection and breeding programs in both East and West Africa for over 30 years. Major breeding objectives have focused on: shorter stalks (around two meters), increased resistance to disease, pests, and drought, hard grains with good storing and eating qualities, and higher and more stable yields. Yields of unimproved sorghum varieties are estimated to average only 600 to 700 kgs/ha under traditional management practices (Etasse, 1977). Yields several times higher have been achieved on experiment stations using improved husbandry practices. In Nigeria, for example, long season improved local varieties have yielded from 2,000 to 4,000 kgs. (Norman, Beeden et al., 1976b).

Two categories of millets are grown in Africa, a short season (75 to 100 days), nonphotoperiodic millet and a long season (120 to 180) photoperiodic millet. Short season millets are generally grown as a "hungry season" crop since they can be harvested a month or more before sorghum is ready. Long season millets are considered to have desirable taste and good storage qualities. Average yields of millets have been estimated to be 580 kgs/ha in West Africa, ranging from a low of 290 in Mauritania to 690 kgs. in Mali (Kassam). In East Africa, yields of finger millet range from 450 to 900 kgs/ha (Acland). Yields of local millet can reach 1,200 to 1,650 kgs/ha under improved practices. In general, genetic improvement research on millet has produced discouraging results in Africa (Etasse). Less progress has been made on research on improved millet varieties than on sorghum.

Major problems have been encountered in importing high-yielding sorghum and millet varieties from other continents. While some hybrid varieties have achieved high yields on experiment stations, many have not performed well under farm-level conditions. For example, if farmers plant short season hybrid sorghum varieties early in the rainy season, as they do with local varieties, the hybrid varieties are often afflicted with head mold because the grain matures before the end of the rainy season. But if farmers wait to plant short season varieties, less time is available for planting cash crops and there is the possibility of sorghum crop failure if the rains end early. Also, many hybrid varieties often have had low germination rates and are susceptible to the parasitic weed striga and

to pests such as army worms. Moreover, since farmers often plant as many as 5 to 10 varieties to take advantage of different soils and rainfall conditions, a single hybrid variety will not meet all the needs of small farmers.

The recent experience of ICRISAT's cooperative research program in West Africa illustrates the problems faced in introducing sorghum varieties from other continents. When ICRISAT initiated its program in 1975, it was hoped that rapid improvements could be made by importing sorghum varieties which appeared promising in trials in India. But the hybrid sorghum varieties from India have not performed well in trials in Upper Volta, Niger, and Mali. ICRISAT has now taken a major policy decision to deemphasize the transfer of sorghum varieties from India to the Sahel. ICRISAT established a major substation in Niger in 1981 in order to develop a long-term (10-20 year) research program for millet and sorghum with primary emphasis on the needs of Niger, Upper Volta, and Mali. This is more evidence that agricultural change is a slow and evolutionary process.

Maize

Research results have been promising for maize, the major staple crop in many temperate regions in Africa. Research has been directed to developing improved open pollinated varieties, synthetics (composites), and hybrids. Maize breeding was launched in Kenya and Zimbabwe[1/] in the early 1930s, primarily for the benefit of European farmers. Heyer and Waweru report that in Kenya "The development of hybrids for the high rainfall areas, and synthetics (composites) for the medium and low rainfall areas, has been extremely successful and widely applied" (1976, p. 203). Since maize seed is divisible (can be sold in small amounts), improved seed has been made available to both large and small farms in Kenya.

Farm-level maize yields in East Africa range from 670 kilos in Tanzania to over 1,000 kgs/ha in Kenya. Under improved management practices, local varieties have yielded nearly 5,000 kgs. and with the combination of improved management, fertilizers, and hybrid seeds, yields have exceeded 8,000 kgs. Gerhart (1975) reported that in district variety trials in Kenya, hybrid seed was found to increase yields 30 to 80 percent depending mainly on altitude. Despite the apparent potential of hybrid maize in Kenya, average farm-level yields of maize have not significantly increased over the last 10-15 years. Most increases in total output have come from expansion in the area cultivated.[2/] Collinson (1982) and research in Zambia (CIMMYT, 1978) and Kenya (CIMMYT, 1977a)

[1/] Zimbabwe, then Rhodesia, in fact became the first country after the United States to release hybrid maize for commercial production (Harrison, 1970).

[2/] Derek Byerlee, CIMMYT, personal communication, October 23, 1981.

have shown that improved agronomic practices are central to improving farm-level maize yields.

In West Africa, farm-level maize yields have averaged around 800 kgs/ha with a low of 500 kgs. in Benin and a high of 1,100 in Ghana (Kassam). In an economic analysis of improved maize in West Africa using a controlled experiment on farmers' fields, Norman, Beeden et al. (1976a) showed that improved maize varieties yielded several times more grain per hectare than improved sorghum and millet. Maize yields of more than 5,000 kg/ha were obtained using oxen cultivation and yields were relatively stable in low rainfall conditions. Norman, Beeden et al. concluded that maize may have great potential for expansion in the Sudanian zone of West Africa.

Flinn and Lagemann (1980) analyzed the farm-level use of a recommended maize package in Imo State, southern Nigeria, and found that the proposed package was "too risky and not sufficiently superior to present practices" to be attractive to farmers. Interestingly, Flinn and Lagemann noted that when considering technical characteristics alone--resistance to termites and lodging, cobs per plant, productivity on poor soils, starch content, softness, fullness and color of the kernals, and taste--the superior aspects of the recommended variety outweighed its inferior ones. As a result, all farmers participating in the experiment retained seed for planting the following year even though the total package was not judged to be successful and ready for diffusion by the extension service.[1/]

Rice

Although research on improved rice varieties has been underway for over 50 years, average farm-level yields of rice are only around 1,000 to 1,200 in swamps (bas fond) and flood plains. Yields of upland rice are around 500 to 800 kgs. (Chabrolin, 1977) and yields of paddy average only 500 to 600 kgs. in East Africa (Acland).

Improved cultivars (cultivated varieties) have demonstrated high yield potential in the range of 3 to 6 tons for upland rice and 10 tons for paddy. A major problem in the development of improved rice varieties is that the life of an individual variety is often limited because of pests and diseases. For example, new strains of blast have emerged as

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[1/] The use of herbicides for weed control on maize has promise of becoming one of the few self-spreading innovations in rainfed farming in Africa. Herbicides have been used on maize in the United States for many years and they are now being rapidly adopted in Mexico. Herbicides are spreading in Kenya and they are in the early stages of diffusion in Mali. John Lichte reports that 2 farmers experimented with a herbicide on maize in a village in southern Mali in 1980 and in 1981 all 30 farmers in the village used the herbicide on their maize fields (Personal communication, November 1981).

rapidly as breeders have developed varieties resistant to the old strains. While cultivars with a high degree of disease resistance have been developed, these have had relatively low yield ceilings and poor grain quality. For an excellent overview of rice in Africa, summaries of rice cropping systems, and genetic improvement programs, see Buddenhagen and Persley (1978).

Wheat and Triticale

Wheat is a minor crop in African agriculture but it is of intense interest to policy makers as urbanization proceeds and growing imports of wheat and wheat flour are needed to meet the rapid shift in consumer preferences to bread. For example, per capita wheat consumption has doubled in Senegal over the 1961-77 period (Senegal, 1977). Satisfactory wheat yields are being achieved in the highlands of Ethiopia and Kenya but CIMMYT reports that wheat yields in the highlands of East Africa have lagged behind the yield breakthroughs achieved in more favorable areas such as the irrigated plains of India and Mexico (CIMMYT, 1981, p. 50).[1/] The highland environment is conducive to disease development; stem and stripe rust are common yield constraints. Although wheat has been promoted for many years in West Africa, wheat yields are disappointing because of high temperature and many technical problems. Most of the present government wheat schemes in West Africa require heavy subsidies.

Although research on wheat is increasing in Africa, there have been few farm-level studies of the economics of wheat production. Unpublished reports and knowledgeable observers indicate that at present wheat cultivation is profitable in certain highland areas of East Africa but is not profitable in West Africa. Wheat might have promise as a second crop, following rice, in some irrigated schemes in West Africa. On-farm research by agronomists and economists is urgently needed in West Africa. Nigeria appears to be pushing ahead with large-scale irrigated wheat production in its northern region in advance of sound economic analyses of irrigated wheat versus other crops or imported wheat (Nigeria, 1980a,b, 1981). We are of the opinion that maize is more promising than wheat in Africa and that there should be an increase in research expenditures for maize relative to wheat.

Triticale is a relatively new crop which was developed by crossing wheat and rye. Triticale has a higher protein content than wheat and it is used mainly for livestock feed in high-income countries.[2/] Triticale is being used for human consumption in East Africa

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[1/] Two of the most technically unfavorable regions for producing wheat--sub-Saharan Africa and Southeast Asia--are the regions where per capita bread consumption is increasing the most rapidly. For a historical perspective on wheat breeding in East Africa, see Guthrie and Pinto (1970).

[2/] Most of the estimated one million acres in world production are in the USSR and North America.

as a blend with wheat flour to make bread. CIMMYT is carrying out an expanded research program on triticale in Kenya, Tanzania, Argentina, Brazil, Chile, and India. Triticale seems to grow well on acid soils in Kenya and Tanzania and it has had few disease problems in East Africa to date. In Kenya, many wheat varieties require fungicides but triticale does not require fungicide application (CIMMYT, 1981).

Cotton

Cotton was introduced in East Africa from the U.S. around the turn of the century and much work has been done on it both genetically and through agronomic research. Breeding and selection initially focused on jassid resistance and then turned to bacterial blight. More recently research has focused on yields of seed cotton, increased length and strength of fiber, and higher ginning percentages (the ratio of lint to seed cotton).

Today there is a large gap between yields on farmers' fields and yields in experiment station trials (M. Arnold, 1976). In East Africa, yields average from 220 to 450 kilos of seed cotton per hectare on small farms. A similar range of yields with indigenous practices has been reported in West Africa (Kassam) and in Nigeria by Norman, Hayward, and Hallam (1974, 1975). Indigenous practices usually entail little or no insecticide or fertilizer and late (July) planting. Improved cotton packages are yielding 800 to 900 kilos of seed cotton per hectare in Nigeria while yields on experiment stations are in the range of 1,200 to 1,300 kilos (Acland). Because cotton yields are often extremely low without complementary inputs of spraying and fertilization, many countries have established parastatal organizations to promote cotton through vertically integrated programs (input supply--controlled management--marketing).

The problems in introducing improved cotton varieties under farmer conditions have been illustrated in research in Nigeria and Malawi. Based on multi-year trials in northern Nigeria, Norman, Hayward, and Hallam (1975) found that sole-cropped cotton was marginally profitable in the first year of trials but was clearly unprofitable in subsequent trials when rainfall was less than average. Also, yields were found to be highly sensitive to the selection of a spraying regime. An important finding by Norman, Hayward, and Hallam was that farmers planted cotton later than recommended dates, despite reduction in cotton yields, in order to ensure that sufficient millet and sorghum could be grown to meet family food needs. Farrington addressed the issue of how many times to spray cotton on small farms in Malawi. Although results of spraying trials conducted at experiment stations on improved varieties often show that as many as 12 sprays of insecticide should be used to maximize yields (e.g., Davies, 1976), the normal practice of small farmers is to apply insecticides at a much lower rate. Farrington showed that over two seasons the normal practice of Malawian farmers of applying insecticide only a few times approached an economic optimum.

Legumes

Research on grain legumes has concentrated on groundnuts and secondarily on cowpeas. Groundnuts are the major cash crop in the West African savanna, reaching their greatest concentration in the northern Guinea and Sudanian zones. In West Africa, average yields are around 710 kgs/ha or about 500 kgs/ha of kernel (Kassam). With improved management, including pest control, experimental yields with improved cultivars range from 3 to 3.5 tons per hectare and have exceeded 5 tons in the Guinea zone. Two of the major breeding goals for groundnuts are to increase the oil content and the protein content (Rachie and Silvestre, 1977). Additional breeding criteria have included (1) seed dormancy to increase the flexibility for leaving groundnuts in the ground, (2) shorter season, and (3) resistance to rosette virus.

Yields of cowpeas in sub-Saharan Africa are extremely low. Average yields are estimated to be around 250 kilos per hectare in West Africa and slightly higher, 350 to 450 kgs/ha, in East Africa (Acland, Kassam). But on-farm yields are often as low as 100 kilos of dry seed (Rachie and Silvestre, 1977). Some major genetic factors limiting cowpea yields are lodging and limited resistance to pests and diseases. In West Africa, improved cultivars have yielded 1.5 to 2.5 tons in the Sudanian zone under experimental conditions and over 3 tons in the Guinea zone. For these high yields to be realized, improved varieties have been sole-cropped at high population densities with chemical pest control. In East Africa, with improved management but without insecticides, yields have reached 2,200 kgs/ha.

The major objectives of cowpea improvement programs have been to develop lines that combine stable yields with resistance to pests, disease, and drought stress. Variety testing programs are underway in Senegal, Niger, Upper Volta, Cameroon, Benin, Nigeria, and Tanzania. Cowpeas are being tested both as an intercrop and under sole-cropping. In the CGIAR system, IITA at Ibadan has assumed worldwide leadership for research on cowpeas. IITA has identified several promising varieties (IITA/SAFGRAD, 1980). Insect damage is a major constraint on sole-cropped cowpea production and pest control accounts for most of the increases reported in experiments relative to local varieties grown with traditional practices (Hays and Raheja, 1977; Ejiga, 1977).

Root Crops

Tropical root crops have been neglected relative to research on cereal crops (Terry, Oduro, and Caveness, 1981). As a result, root crops are still largely unimproved and should have a large potential for future improvement (Coursey and Booth, 1977). Root crops already are at a substantial advantage relative to cereal grains in forest zones where, for example, yams can produce more protein per unit of area and cassava more energy per unit of labor than rice.

Cassava was initially grown in the forest areas of West Africa but since the turn of this century it has been slowly moving into the northern savanna zones (W. O. Jones, 1959). In East Africa, cassava is widely grown in areas below 1,500 meters. Local varieties of cassava have low yield potential even under improved practices (Coursey and Booth). Estimates of cassava yields in Africa range from 6.7 to 10 tons of fresh tubers. The most common estimate of 7 tons is half the estimated 14 tons/ha achieved on average in Latin America (Onwueme, 1978).

The major breeding objectives have been resistance to pests and disease--particularly mosaic disease and bacterial blight, increased yield potential, higher starch and protein content, lower fiber, and trying to combine early maturing with good storing properties. Although relatively little crop improvement research has been conducted on cassava until recently, major strides have been made in increasing the yield potential of cassava in Africa. Selected varieties have yielded 20 to 40 tons per hectare of fresh tubers under experimental conditions and hybrids have reached as much as 50 to 70 tons (Coursey and Booth). African mosaic disease and limited response to improved soil fertility continue to be major constraints.

There are innumerable varieties of yams grown in West Africa, where yams originated and where two-thirds of the world crop is grown. Yields of yams continue to be low, ranging from 5 to 10 tons per hectare when grown under traditional conditions (Coursey and Booth). IITA is the leading center for yam breeding and selection. The main breeding objectives are to increase yields, tolerance to disease and protein content; to develop semi-erect plants so they will not need staking; and to shorten the growing season. Research at the IITA has indicated yield potential of selected varieties of 30 to 50 tons/ha in favorable climate and yields have exceeded 60 tons/ha (Kassam). A major constraint on yam improvement is that many species of yams have been propagated vegetatively for such a long time that they flower irregularly and have reduced ability for sexual reproduction (Onwueme). See Bachmann and Winch (1979) and Diehl and Winch (1979) for descriptions of yam-based farming systems in Nigeria; Lawani and Odubanjo (1976) for a bibliography on yams; and Onwueme and Terry, Oduro, and Caveness for research strategies for root crops.

Soil Fertility and Fertilizer

Soil Resources

Soil deficiencies are a major constraint on African agriculture (Ahn, 1977). Soils in the Savanna are extremely weathered, the chemical status is poor due to difficiencies in phosphate and organic nitrogen, and the amounts of phosphorus and sulphur mineralized annually are often below requirements of high crop yields. Soil deficiencies often are

attributed to poor parent material. The nutrient content of soils also has been greatly reduced over the years through leaching during heavy rains and because nitrogen, organic material, and other elements such as sulphur have been lost through the traditional system of clearing land by fire. The porosity of many African soils is low, leading to problems with high water run-off during intense rains and a tendency for soils to compact under wet conditions. The degree of hardness of soils and resistance to penetration is often 5 to 10 times higher in the dry season than in rainy seasons. Descriptions of soils in Africa can be found in Ahn (1969, 1977), Jones and Wild (1975), Charreau (1977), Kowal and Kassam (1978), and Obeng (1978).

Concern with soil erosion has increased dramatically in recent years. Historically, erosion has been a minor factor influencing agricultural systems since only a small proportion of land was cultivated at one time and fallow periods were sufficiently long to allow soils to fully regenerate. However, increasing population densities have led to an increase in the proportion of land cultivated and a reduction in fallow time resulting in severe erosion problems in some areas. For surveys of research on soil erosion and conservation, see Fournier (1967), FAO (1973), Greenland and Lal (1977), Fauck (1977), and Roose (1977).

Fertilizer Use

Fertilizer use is extremely low in Africa and almost totally restricted to cash crops such as tobacco, cotton, tea, and groundnuts. For example, less than one kilo of fertilizer per hectare of arable land in crops was applied in Nigeria in 1970 as compared with 83 in the United States and over 200 kilos per hectare in Europe (Falusi, 1976). In a valuable assessment of technical and economic research on fertilizer in West Africa, Zalla, Diamond, and Mudahar (1977) reported that fertilizer use averages less than two kilos of nutrients per hectare in West Africa. Mudahar (1980) reported that the highest use of fertilizer is in Zimbabwe followed by Kenya, Liberia, Senegal, Sudan, and Zambia with rates ranging from 10 to 25 kilos per hectare. In Angola, Ghana, Malawi, and Tanzania, farmers use an average of 5 to 10 kilos per hectare while farmers in most other countries use under 5 kilos.

Yield Response

Fertilizer research on experiment stations has produced varied results. In West Africa, research has shown that rice, cotton, and maize varieties cultivated as sole crops have responded well to fertilizers while responses for sorghum and millet have been somewhat lower (Zalla, Diamond, and Mudahar). Amon and Adetunji (1973) found in research on maize, yams, and cassava over the 1964-69 period in the Savanna zone of Nigeria that maize significantly responded to small dressings of N, P, and K but that

higher treatment levels did not significantly increase yields. Bigot (1977), in a review of tests in the Ivory Coast over an eight-year period, found that when rainfall was average or better a composite NPK fertilizer had a positive effect on cotton and yam yields.

Acland reported that rice, cassava, and plantains have shown little response to fertilization in East Africa while sorghum has responded well to manure, nitrogen, and phosphorus. Acland also found that cotton has generally responded well to nitrogen but that phosphorus and potassium have little effect on yields. Nitrogen has been found to have a large impact on maize yields in East Africa (10 to 15 kilos of maize per kilo of nitrogen) but the effect appears to be highly dependent on the level of crop management.

Rock and soluble super phosphates have received particular attention in fertilizer research since nearly all African countries must import sources of nitrogen while phosphate deposits are available in several countries.[1/] Long-term phosphate trials in Samaru, Nigeria revealed that rock phosphates were more promising than super phosphates because of the high cost of super phosphates (M. Jones, 1973). Zalla, Diamond, and Mudahar reported that the application of 40 to 160 kilos of rock phosphate per hectare gave significant increases in yields in several trials in West Africa and that phosphate rock was generally 50 to 90 percent as effective in increasing yields as calcium phosphates or triple super phosphates. For a comparison of results with phosphate deposits from several West African countries, see Truong Binh, Pichot, and Beunard (1978).

An alternative means of maintaining soil fertility without turning to imported fertilizer is the use of manure. The modest research to date on this topic has focused on how manure influences soil productivity as farmers move from shifting to continuous cultivation. Based on a review of research on cotton, sorghum, and groundnuts carried out over two decades in Nigeria, Lombin and Abdullahi (1977) concluded that soil fertility and productivity could be maintained under continuous cultivation and application of manure but they add that few farmers have sufficient manure to keep their land under continuous cultivation. This may explain why farmers throughout Africa often use manure primarily on relatively high-valued crops near the household (compound) (see, for example, Lassiter, 1981; Lagemann, 1977).

The generally positive findings about the effectiveness of fertilizers in increasing yields must be treated with caution because of the lack of research conducted under management levels and resource constraints on small farms. Moreover, many fertilizer trials have been carried out on new plant varieties which generally have the capacity to

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[1/] Since potassium levels are high in most African soils, the addition of potassium has generally had a relatively minor effect on the yields of most crops.

make effective use of relatively larger quantities of plant nutrients. Robinson and Falusi (1974) point out, for example, that recommended fertilizer application rates for improved varieties are often three to four times the recommended application rates for traditional varieties and as much as ten times the average amounts actually applied by small farmers. As a result, more attention is needed in quantifying the farm level response to fertilizers over a number of years. The limited data on farm-level response show that responses of sorghum and millet are generally about one-half those realized at experiment stations. Farm level yields of rice have been much closer to experiment station trials but on-farm results have been extremely variable (Zalla, Diamond, and Mudahar).

Profitability of Fertilizer

There have been few attempts to evaluate the profitability of using fertilizers or to identify optimal use rates. Moreover, only a small proportion of the available studies refer to responses achieved under farmer conditions. Falusi (1976) reported that demonstration trials in Nigeria have shown that returns from fertilizing crops like groundnuts, rice, and yams are relatively favorable while returns to fertilizer on sorghum have been only marginally profitable. Falusi also noted that expected returns were highly variable, especially for upland food crops. More recently, Falusi and Williams (1981) reported that at the existing subsidized price of fertilizer in Nigeria, the value:cost ratio for all major food crops exceeded 5, with the highest returns to fertilizers being realized on root crops--cassava and yams. The evidence indicated that fertilizer use would be profitable even if fertilizer was not subsidized.

In Uganda, H. L. Foster (1978) found that in 3,000 trials of N and P on large farms, yield responses of cotton were generally large enough to make the use of N and P profitable. Foster (1980) showed that it was profitable to use fertilizer on groundnuts and that groundnut yields without fertilizer had a coefficient of variation of 20 to 30 percent. The profitability of fertilizer on both cotton and groundnuts was strongly influenced by: (1) soil organic content; (2) amount of previous cultivation; and (3) average hours of sunshine. The response of cotton was also influenced by the soil ph. Vadlamundi and Thimm (1974) analyzed the economics of fertilizer trials on maize in Kenya using quadratic production functions with N and P as the variable inputs. Their economic analysis included deriving the MPPs of each nutrient for given levels of the other nutrient, identifying yield isoquants, and presenting nutrient isoclines for a range of price ratios. Montgomery (1977) synthesized experiment station results in Mali and Upper Volta and found that for both sorghum and millet a light dose of fertilizer was profitable while a heavy dose was only profitable for millet. But farmers use almost no fertilizer or millet in these countries today.

Several methodological issues have been raised in attempts to evaluate the profitability of using fertilizer and other purchased inputs. Lang and Bartsch (1977) discussed a method for evaluating the economics of improved practices, including use of fertilizer, in the face of uncertainty about rainfall. By statistically estimating the relationship between yield responses and rainfall, they were able to project the probability of yield responses using historical data on rainfall patterns. In an illustration of their method, they showed that fertilizer use was highly profitable in the Ivory Coast in most years, particularly for yams, rice, and cotton. Pieri, Ganry, and Siband (1978) argued that three major factors must be considered in evaluating the profitability of fertilizer use: economic profitability, the incentive to use fertilizers, and the need to restore minerals removed to maintain soil quality over time.[1/] Flinn (1975) argued that research on the economics of new inputs and practices should (1) use a non-zero discount rate in establishing the marginal factor costs of resources in order to represent the time dimension of investing in variable inputs, (2) use effective prices received and paid by farmers (including transport costs), and (3) concentrate on input levels which yield stable returns rather than on identifying maximum profits, since slightly increased returns may greatly increase risk.

Demand for Fertilizer

Ogunfowora and Norman (1973) found that the demand for fertilizer was influenced by the availability of working capital, followed by fertilizer cost and output prices. Mwangi's study in Kenya (1978) also showed that capital availability and fertilizer prices were more important determinants of fertilizer demand than product prices. But in northern Nigeria, Etuk (1979) found that the optimum level of fertilizer use was relatively insensitive to a change in the price of fertilizer. The lack of working capital was found by Robinson and Falusi to be a major constraint on fertilizer use in Nigeria. Falusi (1974/75) showed that the variables representing the wealth of farmers had the biggest effect on the decision to use fertilizer in Nigeria. Falusi (1976) reported that in a survey of Nigerian farmers carried out in 1971 over half of the farmers cited a lack of money or credit as the major reason they did not use fertilizer; 40 percent said they did not apply more fertilizer because it was not available. Falusi and Williams (1981) identified the following factors as constraints on fertilizer use in Nigeria: (1) low returns to investment in land in bush fallow farming systems; (2) absence of fertilizer-responsive varieties; (3) moisture stress in drier areas; and (4) inadequate extension support.

[1/] They derive a feasible region where all constraints are met and show that the optimal level of fertilizer use will vary depending on which factors are taken into account.

Research on Managerial Practices

Historically, agronomic research programs focused on identifying optimal practices to maximize yields of improved varieties under different soil and climatic conditions. In the 1960s, the large gap between yields achieved with improved practices on experiment stations and those on farmers' fields gave rise to the view that indigenous practices had to be abandoned before major breakthroughs could be made in farm-level yields. But in the 1970s, both social and technical scientists developed increased respect for and interest in the value of indigenous practices of small farmers. The focus of most agronomic research programs in sub-Saharan Africa now encompasses alternative management practices, including indigenous practices. We shall review research on: (1) intercropping; (2) plowing; (3) crop rotations; (4) sowing dates; and (5) planting densities.

Intercropping

Intercropping refers to the indigenous practice of producing two or more crops on a field at the same time. According to Belshaw (1979), extensive research was undertaken on intercropping in Africa as early as the 1930s. But over the 1930-1960 period, colonial administrators and researchers considered intercropping to be irrational and urged farmers to substitute sole cropping and planting in rows for intercropping. Intercropping research was reactivated in some countries in the 1960s and now has become a major component of several national programs. Several potential technical advantages of intercropping include: (1) legume intercrops fix nitrogen; (2) intercrops which spread and cover the entire ground surface reduce weeds and the time which must be spent on weeding; (3) mixtures can be grown at higher densities than equivalent areas of sole-cropped fields; (4) fewer insect and disease problems relative to sole cropping; and (5) differences in the heights and age of crops in mixtures at maturity enable a farmer to exploit a limited area of high quality soil with minimal competition between crops.

Research on the economics of intercropping was initiated at Ahmadu Bello University in northern Nigeria in the mid-1960s. The results have shown that, although the returns to individual crops often are lower when grown in mixtures, farmers achieve higher gross and net returns per hectare for crops grown in mixtures. Norman (1974) estimated that the average return per hectare of intercropping was 35 percent higher than sole cropped fields. Ogunfowora and Norman (1974) and Andrews (1972, 1974) showed that there is an advantage to intercropping even when using improved varieties that have been bred to be sole cropped. E. F. I. Baker (1978-80) reported that in a series of trials, mixed systems of cereals and groundnuts, cereal, groundnuts and maize, cereals and cotton, and mixtures of cereals all increased returns per hectare relative to sole cropped fields.

Intercropping has received somewhat more qualified support in other countries in Africa. Mercer-Quarshie (1979) for example, found in a test of 14 mixtures of 5 varieties of sorghum grown in 11 different agro-climatic zones in northern Ghana that each mixture yielded less than the best individual crop in that mixture but that the average yield of each mixture was higher than the mean yields of its individual crops. Moreover, the mean yields of mixtures were more stable. Mercer-Quarshie concluded that the stability of yields is a more important reason for intercropping than increases in yield or gross income. In a series of intercropping trials in Kenya, N. Fisher (1977) reported mixed results for maize and beans and maize and potatoes. Fisher found that in short rainfall seasons, maize and beans and maize and potatoes competed for water, and yields from mixtures were less than yields from an equivalent area of each crop grown as a sole crop. But in a follow-up study, Fisher (1979) reported that in the long rain season, there was a clear advantage of maize and bean intercropping. Fisher concluded that mixtures are more efficient where yields of pure stand are low but that there is little difference between sole and intercropping where the yields of pure stands are high.

In summary, research in Africa and Asia has convincingly shown that intercropping is a desirable practice for smallholders because it serves as a hedge against crop failure, increases the variety of food for a family with a land constraint (Flinn and Lagemann, 1980), and can increase the returns to labor during the peak seasons (Okigbo and Greenland, 1977; Monyo, Ker, and Campbell, 1976). Research stations should incorporate intercropping as a standard component in their experimental design.

Plowing

Research on plowing has focused on the impact of deep plowing, versus minimum or no tillage on yields and soil quality in the long run. Charreau (1977) contends that plowing has a major beneficial impact on yields of crops grown on soils with a clay content of under 20 percent; this applies to much of the arable land in West Africa (Jones and Wild, 1975). Charreau further argues that the benefits of plowing have often not been realized due to low quality plowing. Strong support for the benefits of plowing was presented in a series of reports on trials in Senegal by Charreau and Nicou (1971). IITA/SAFGRAD (1980) reported that in trials on maize, zero tillage and hand hoeing gave significanty lower yields (2,000 kgs/ha) than did oxen plowing. Barrett et al. (1981) found that plowing increased yields of sorghum and groundnuts in eastern Upper Volta and that there was even a greater increase if phosphate rock was incorporated. Chopart and Nicou (1976) provided evidence that plowing increases yields and tends to increase drought resistance because it increases the porosity of soils and enables plants to establish stronger and deeper root systems. Ahn (1977) points out that there is a general consensus among

French soil scientists, who have played a leading role in soil research in West Africa, that plowing can have a major positive effect on yields.

It has been common to evaluate plowing in conjunction with fertilization and incorporation of straw to increase the organic content of soils. On the basis of trials over a five-year period on rice in Senegal, Beye (1977) reported that the combined effect of nitrogen with plowing under of straw had a significantly positive effect on yields. The effect of nitrogen alone was also positive but less than the combined treatment. On the other hand, Bigot (1977) found in the Ivory Coast that plowing had little effect on yields of cotton, maize, rice, and yams relative to hand hoes and that the beneficial effects of plowing did not overcome the effect of bad rainfall.

In general, there appears to be evidence that plowing, particularly when complemented by incorporation of organic material or fertilizers, can have a positive effect on yields, depending on soil properties and quality of plowing. But the question of the impact of plowing on soil quality in the long run remains unanswered. A common weakness of research on alternative soil tillage techniques is that there have been few economic or technical studies on farmers' fields. IITA has an active research program underway on minimum tillage. This is an especially important topic in light of the rising energy cost. But to date minimum tillage has been found to be plagued with weed problems. As a result, herbicides are being added to minimum tillage experiments. Minimum tillage is a long-term research problem area. To date there are no concrete recommendations for farmers.

Crop Rotation

Crop rotation has long been practiced to take advantage of different levels of soil fertility, to counteract weeds and to take advantage of residual soil fertility either from fertilizer on a previous crop or from a legume in the rotation. For example, crops such as yams are often planted soon after a plot is out of fallow since they have high nutrient requirements while cassava is generally the last crop planted in a rotation. Rotations of sorghum and millet have also been used to counter striga. IRAT is currently testing several binomes (combination of two crops) in its work on crop rotation (Nicou, 1978; IRAT, 1980). An important topic is the impact of continuous cultivation of a single crop or a rotation of crops on soil quality over a 10-15 year period (Fauck, Moureaux and Thomann, 1969; Charreau, 1972).

Sowing Dates and Planting Density

Since yields of most crops decline with late sowing, an important research issue is the relative sensitivity of different crops to late sowing. The sowing date of cotton has received a large amount of attention because small farmers consistently plant cotton

later than recommended dates (Norman, Hayward, and Hallam). Results have shown that the time of sowing does have a significant effect on yields of both cotton and maize. In general, late sowing of photosensitive varieties can reduce yields which cannot be offset by changes in soil preparation and fertilization (ICRISAT, 1980c; Kassam and Andrews, 1975).

Plant density has also received attention in agronomic trials because African farmers traditionally plant at intervals exceeding those used on experiment stations and recommended by extension services. This indigenous practice represents an adjustment to the low fertility of many African soils and the need to conserve soil moisture to fill grain after the rains have stopped. There appears to be an important interaction between sowing date and plant density, at least for local varieties of certain crops such as sorghum and millet which tiller. Early planting of tillering varieties of sorghum at wide spacings stimulates vigorous tillering, resulting in increased yields relative to later planting at higher densities (ICRISAT, 1980c). For research findings on sowing dates and plant densities, see ICRISAT (1980c) and IRAT (1980).

Synthesis

Every country in sub-Saharan Africa has national research programs which conduct a wide range of agronomic experiments. While substantial increases in yields of export crops have been achieved on experiment stations and on farms, there are few areas in Africa where there are proven food crop packages ready for farm-level adoption. The 1979-85 five-year plan in Kenya, for example, discusses the lack of new technologies available for immediate adoption by small farmers (Kenya, 1979b) even though Kenya has a history of agronomic research dating from the 1920s. Historically, investment in research on export crops such as cocoa, tea, and coffee has greatly exceeded that of food crops. Not unexpectedly, progress in increasing yields, yield stability, and disease resistance has been greater on export crops than food crops with the exception of maize in a few countries such as Kenya, Zimbabwe, and Malawi.

There are many reasons for the lack of progress in generating food crop technology which is relevant to small farms. First, there is a gap between resource endowments of experiment stations and small farms. For example, soils on research stations often have a history of better management, including previous applications of fertilizer and dry season conservation practices. Experiment station plots are usually plowed and seeded at optimal times, weeding often exceeds levels practiced by small farmers, and complementary inputs such as insecticides and fertilizers which are routinely used on experiment stations are often not available to farmers in village markets. As a result, many of the technical recommendations presented to farmers have proven to be overly optimistic.

Second, many of the technical packages which increase yields and yield stability call for practices which are not consistent with the goals of farmers or their "prevailing wisdom" about optimal cultivation practices under environmental uncertainty. For example, researchers frequently have recommended early planting of cash crops in rows even though most farmers have traditionally intercropped and planted food crops before cash crops, believing that these practices increase the probability that household food requirements can be met even in low rainfall years. As a result, farmers have selectively adopted some of the components of technical packages such as an improved variety, applying a small amount of fertilizer, or changing planting dates rather than adopting the entire package. Even where entire packages have been adopted, farmers generally have done so sequentially over a period of several years. Thus, there is a continuing need to take into account the goals, resource endowments, and constraints faced by farmers in designing on-station research. Finally, there is a need to increase on-farm research of promising technology. On-farm trials and the linkages between commodity research and farming systems research are discussed in the section on farming systems research below.

Irrigation

Irrigation plays an insignificant role in sub-Saharan Africa except the large-scale projects in the Sudan and in Madagascar where there is a history of irrigation by small farmers. With the exception of Sudan and Madagascar, the percent of cultivated land under irrigation is probably less than 5 percent in most other countries.[1/] This compares with around 30 percent in India. But irrigation is important in the river valleys of Zimbabwe, Somalia, Ethiopia, and Mozambique and in parts of Mali, Senegal, and northern Nigeria. Also, there are numerous indigenous irrigation techniques which have been finely honed to local ecological conditions. For example, one system is planting crops (usually rice) in small swamps (see Welsch, 1965) or what are called bas fonds in Francophone Africa. Another is the use of small streams on mountains. The Chagga people on the hills of Mt. Kilimanjaro in northern Tanzania have developed an intricate network of small streams and ditches which criss-cross the entire mountain and support a banana, coffee, and dairy cattle farming system. In many parts of Africa, the shadoof is still used to lift water to irrigate small patches of vegetables. Flood recession farming is of major importance in Mali. Under this system, river bottom land is planted to crops as the flood water recedes. But public irrigation projects and indigenous water control systems are little more than footnotes in African agriculture.

[1/] Because of the lack of an agreed upon definition of "irrigation cultivation" there is no consensus on the percent of land in sub-Saharan Africa under irrigation except that it ranges from 1 to 5 percent.

The token role of irrigation in sub-Saharan Africa is understandable in light of the abundant land available in most African countries and the simple fact that the marginal cost of bringing more rainfed land under cultivation has been substantially less than the cost of leveling and preparing land for irrigation. For example, the World Bank (1981b, p. 79) reports that recent irrigation projects in Niger, Mauritania, and northern Nigeria all had costs of more than $10,000 per hectare in 1980 prices. A recent CILSS/Club du Sahel report reports that the cost of irrigation development in the Sahel is running between $5,000 to $20,000 per hectare (1980b). On the other hand, small perimeters are being built in Senegal with only several hundred hours of family labor per hectare (Fieloux, 1980).

During the past five years, there has been a dramatic increase in interest in irrigation in Africa because (a) the 1968-74 drought in the Sahelian region of West Africa, Sudan, Somalia, and subsequent droughts in Kenya and Tanzania (1973-74) stimulated interest in irrigation as a means of reducing the dependency on rainfed agriculture (AID, 1976; Club du Sahel, 1977); (b) the frontier stage is almost exhausted in countries such as Kenya and Senegal and, as a result, increases in agricultural output will require investments to intensify production, including multiple-cropping on irrigated land; and (c) Africa's food crisis has focused attention on the need to increase both rainfed and irrigated land under cultivation.

Potential for Irrigation

Most observers feel that there is a large, untapped potential for increasing the proportion of arable land which is irrigated in sub-Saharan Africa. But the potential for increased irrigation is still unknown because of the lack of soil mapping, hydrological surveys, and soil and agronomic research for irrigated farming. For example, Carruthers and Weir (1976) estimated that the potential land available for irrigation in Kenya was 230,000 hectares in 1976 but this figure was adjusted upward in 1977 and 1978 as more technical information became available. In 1979, the government of Kenya estimated that 540,000 hectares of land were available for irrigation (Toksoz, 1981). Regardless of which figure one accepts, the potential for expanding irrigation in Kenya is large since only 26,000 hectares, or between 5 and 10 percent of the potential, are currently under irrigation. The FAO has estimated that the Sahelian region of West Africa has about 12 million acres of land which is potentially available for irrigation if water is available (FAO, 1976b). The Club du Sahel, however, estimated that only 80,000 hectares was under irrigation in the mid-1970s (1977, p. 27). The gap between 80,000 and 12,000,000 hectares is staggering and even if the FAO estimate is cut in half to 6 million hectares the potential for irrigation is enormous. In summary, even though estimates of the potential

land for irrigation are some of the weakest data for any sub-sector, the technical potential for irrigation is large and estimates likely will be increased as more information becomes available (such as the CILSS/Club du Sahel, 1978b, report on "new lands").

Country and Regional Experiences

Irrigated farming dominates the agriculture sector in the Sudan with its Gezira and Rahad schemes. The Gezira scheme of 740,000 hectares was founded in 1925 in an area south of Khartoum. Cotton is the main export crop supplemented with millet, groundnuts, wheat, and rice. Cotton exports are handled through the government's Gezira Board. Gaitskell (1959) is a standard reference on the Gezira scheme. Although the Gezira scheme is often cited as the most successful large-scale irrigation project in Africa, large irrigation projects in the Sudan have been plagued by the common problems of lack of participation of farmers in decision making, lack of flexibility in choosing crops, and difficulties in adjusting the size of farms in response to changes in the life cycle of tenant families. For a radical critique of the Gezira scheme, see Barnett (1977, 1979, 1981). Because of a limit on the amount of water which the Sudan and Egypt can each draw from the Nile River, rainfed agriculture is now receiving greatly increased priority in the Sudan (ILO, 1976). This is in contrast to many other countries in sub-Saharan Africa where policy makers are concerned with speeding the transition from rainfed to irrigated farming.

Irrigation in northern Nigeria has its roots in colonial policy. This was reinforced in the postindependence period when the government pushed ahead with irrigation in northern Nigeria (Wells, 1974) even though the FAO estimated in 1966 that the cost of irrigated wheat production was $168 per ton as compared with a landed cost of imported wheat of $84 a ton (FAO, 1966, pp. 180-181). Irrigation looms large in Nigeria's planning for the 1980s and 1990s. For example, Nigeria is reported to be planning to invest $2 to 3 billion to bring about 300,000 hectares under irrigation during the next two decades with priority given to producing wheat during the dry season. Unfortunately, there are few hard figures on the costs and returns of irrigation in northern Nigeria but many observers contend that large-scale irrigation projects are unproductive. The World Bank reports that Nigeria is shifting its emphasis away from large-scale irrigation to small-scale irrigation based on ground water development by hand operated and small motor-driven pumps (1981, p. 80). For a historical perspective, see Palmer-Jones' "How Not to Learn from Past Irrigation Mistakes" (1981). For a pessimistic view of the Kano River project, see Wallace (1981). For an assessment of small-scale irrigation in western Nigeria, see Ansell and Upton (1979).

In Francophone West Africa, many irrigation projects were developed by the French colonial service and the remains of these projects are visible in almost every country. The Office du Niger project on the Niger River in Mali was the centerpiece of French colonial irrigation projects in West Africa. It was started some 60 years ago to grow cotton and rice when it was observed that rainfed cotton often failed in the Sudanian zone (De Wilde et al., 1967; W. I. Jones, 1976). A French parastatal--Office du Niger--was created in 1921 to carry out the development of the 1 million hectare scheme. The colonial service relied heavily on forced labor (until 1945) to develop the infrastructure (Magasa, 1978). During the peak settlement period, only a small proportion of the projected 1 million hectares was settled but the Office du Niger was given a reprive by the 1968-74 drought and several donors are now helping finance the rehabilitation of the infrastructure. The first farm-level study of the economics of rice production in the Office reveals that rice yields at the farm level are lower, 1.7 metric tons per hectare, than previously assumed by the government and several donors and that government taxes are a major constraint on the profitability of rice production by small farms (Kamuanga, 1981).

Four river basin complexes are currently being rehabilitated or developed in the Sahelian region of West Africa: the Office du Niger in Mali, the Volta River Valley Project in Upper Volta, the Lake Chad River Basin Commission (LCBC), and the Senegal River Valley Development Authority (OMVS).[1/] The $900 million OMVS project on the Senegal River is the largest river basin project underway in West Africa at this time. Under the OMVS project, Mali, Mauritania, and Senegal are building dams at the estuary (Diama) and upstream (Manantali) and financing related investments to (a) regulate the flow of the Senegal River in order to arrest flooding and the incursion of saltwater, (b) provide hydroelectric power, (c) expand river navigation and fishing, and (d) regulate and increase the supply of water for irrigated crop and livestock production. The OMVS optimistically projects that it will be possible to expand the present 30,000 hectares of land under irrigation to 375,000 over the next 20 to 30 years. Clearly, there is a need for a large amount of technical, social, and economic research to guide the development of irrigated farming in the OMVS project area. And there is a need to keep in mind that many big schemes have failed in the past (see K. D. S. Baldwin, 1957).

After the 1968-74 drought in the Sahel, there was a great deal of optimism about the role of irrigated farming in "drought-proofing" the Sahel. But recently the CILSS/Club du Sahel working group on irrigation reported in a remarkably candid assessment that because of numerous technical and administrative problems the projected

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[1/] Organization pour la Mise en Valeur du Fleuve Senegal.

expansion of irrigation in the Sahel is falling behind schedule (1980b). In summary, irrigation is not a panacea for the recovery of Sahel in the 1980s and 1990s. It remains to be seen whether irrigation will be cost effective when it comes on stream in a major way in the early part of the 21st century.

Economics of Irrigation

At present, there are only a few studies of the economics of irrigation in sub-Saharan Africa. Chambers and Moris (1973) traced the history of the Mwea irrigation project in Kenya for two decades and report that it was financially successful for small farmers and that it has produced some of the highest rice yields in the world. Carruthers and Weir (1976) examined five government schemes for small farmers, including the Mwea scheme, and recommended that small-scale irrigation and horticulture research should be expanded in Kenya. But Toksoz (1981, pp. 32-33) contends that the per hectare cost of land reclamation (through drainage and flood control) appears to be less than one-fourth to one-half the cost of irrigation projects. Toksoz recommends that priority should be given to land reclamation projects and the expansion of small-scale irrigation in Kenya.

Sparling (1981) surveyed the sparse literature on the economics of irrigation in Sahelian West Africa[1/] and tentatively concluded that (1) small-scale perimeters will be more profitable than large-scale perimeters and (2) large irrigation perimeters are unprofitable for rice production. Sparling contends that the social profitability of small perimeters almost surely will exceed their private profitability because of the multiplier effects (indirect effects) for those who provide increased goods and services to farmers whose incomes have risen. (See Bell and Hazell's, 1980, study of the key role of indirect benefits in a rice irrigation project in Malaysia.)

Although there is growing evidence that small-scale irrigation is more successful than large projects, there are cases where large-scale irrigation systems or combinations of small- and large-scale irrigation can meet both efficiency and equity goals. For example, Hazlewood and Livingstone's (1978) linear programming analysis of large- and small-scale irrigated farming in Tanzania showed that the area under rice can be maximized by continuous production both on large state farms and through small-scale village production. The complementarity of the two production systems depends on different monthly water requirements stemming from assumed cropping patterns on large and small farms. J. A. Smith (1978) emphasizes another complementarity in a study of large-scale irrigated sugar schemes in Kenya. Smith argues that estates can produce seed cane for smallholders enabling smallholders to undertake cash cropping. Moreover, once

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[1/] See Boutellier (1980); Diallo (1980); Fieloux (1980); Manteuffel and Tyner (1980); Weigel (1980); and Weiler (1979).

nearby smallholders are in full production, estates can be used to regulate the flow of cane to processing mills, assuring the financial feasibility of processing mills.

Synthesis and Research Direction

Although research on the economics of irrigation is fragmentary, the preliminary results provide support for a small-scale irrigation strategy in the 1980s with priority given to increasing flood recession farming, ground water development with small pumps, land reclamation through drainage and water control, and an increase in small perimeters which are developed and maintained by family labor. Second priority should be given to improving the performance of existing large perimeters and river basin complexes by investments to rehabilitate and upgrade the infrastructure on schemes such as the Office du Niger in Mali. Once again these are preliminary guidelines for sub-Saharan Africa. There can be important exceptions, of course, when one examines the economics of alternative irrigation systems in a given area.

The big issues to be addressed by researchers in the 1980s are the economics of rainfed versus irrigated farming in site-specific locations, the choice between large (500 to 1,000 hectares and up) versus small irrigation perimeters, and whether irrigated land should be managed by government agencies and farmed by tenant farmers or managed by associations of farmers and farmed by small farmers.[1/] The scope of irrigation research in Africa should include historical studies of indigenous irrigation systems (e.g., Saunders, 1980); lessons from past mistakes (Palmer-Jones, 1981); the social impact of resettlement components of River Basin projects (Scudder, 1973; Scudder and Colson, 1972); and the potential of land reclamation (Toksoz, 1981) as an alternative to investment in irrigation. Policy makers and researchers in Africa can learn a great deal from the Asian experience with indigenous systems of irrigation management (Coward, 1977); distribution of water in canal projects (Bromley, Taylor, and Parker, 1980); problems of implementing and managing irrigation schemes (Bottrall, 1981); and the role of social science research in helping to design, implement, and evaluate irrigation and land reclamation projects (Coward, 1980).

[1/] Maas and Anderson point out that the single most important finding of their comparative study of six major irrigation projects in the United States and Spain was the importance of "allowing water users to control their destinies as farmers, the extent to which the farmers of each community, acting collectively, have determined both the procedures for distributing a limited water supply and the resolution of conflicts with other groups over the development of additional supplies" (1978, p. 366). This experience provides an alternative to the top-down centralized style of operating public irrigation projects in Africa, whereby the farmers are tenants or "quasi-tenants" of the state.

Irrigation References

Literature Reviews: Des Bouvrie and Rydzewski (1977); Bromley, Taylor, and Parker (1980); and Sparling (1981).

Asian Experience: Coward (1977, 1980); and Bottrall (1981).

Africa: Gaitskell (1959); Welsch (1965); FAO (1966); De Wilde et al. (1967); Thornton and Wynn (1968); Chambers (1969, 1970); Chambers and Moris (1973); Wells (1974); Steedman et al. (1976); FAO (1976b); W. I. Jones (1976); Carruthers and Weir (1976); Club du Sahel (1977); A. Adams (1977b); Palmer-Jones (1977b, 1981); T. Barnett (1977, 1981); Hazlewood and Livingstone (1978); Maas and Anderson (1978); AID (1978); J. A. Smith (1978); Magasa (1978); Weiler (1979); Ansell and Upton (1979); Bell and Hazell (1980); Coward (1980); Boutellier (1980); Saunders (1980); Fieloux (1980); Diallo (1980); Manteuffel and Tyner (1980); Toksoz (1981); CILSS/Club du Sahel (1980a,b); Weigel (1980); Blackie (1981); Kamuanga (1981); Fortmann and Roe (1981); and Wallace (1981).

Animal and Tractor Mechanization

For centuries, farming has been carried out in Africa with human labor and the machete which was used to clear the bush in shifting cultivation systems. Various types of short handle hoes are used in land preparation for weeding and for making heaps and ridges. The present-day importance of the hand hoe is illustrated in Kenya where it is estimated that 84 percent of the arable land is cultivated by hand hoe, 12 percent by oxen, and 4 percent by tractor. These ratios are fairly common in Africa.

Since the early 1900s, colonial and later independent African governments tried to help farmers replace the machete and hoe cultivation with oxen, donkey, and tractor mechanization.[1/] The rationale for mechanization ranges from increasing agricultural output and profit to relieving the drudgery in rural life. But Africa's history is littered with discontinued animal traction schemes sponsored by missionaries, colonial governments, and more recently by foreign aid programs. Even though Africa's experience with oxen and tractor mechanization has generally been unsuccessful, the mechanization of agriculture is almost inevitable. The crucial policy question today is what types of mechanical power are appropriate in low-wage economies with abundant land, seasonal labor bottlenecks, and real energy prices which have increased four-fold since 1973. The task for researchers is to aid in developing improved tools and implements to raise labor productivity in agriculture, to break seasonal labor bottlenecks, and to promote the transition from hand to animal and tractor cultivation in as socially desirable a manner as possible.

[1/] Mechanization is defined as any form of power used to assist or replace hand labor in agriculture, including donkey power, oxen power, tractors, combines, and mechanical threshers.

Methodological Issues

There are major methodological problems in carrying out research on mechanization (Gemmill and Eicher, 1973). The first is the need to shift more research from ex post to ex ante while ensuring that previous ex post results are incorporated into the design of ex ante research. Ex ante research can project some of the likely economic, social, and technical consequences of alternative farming systems, including alternative approaches to performing specific tasks in agricultural production and harvesting. But ex ante research needs to be supplemented with on-farm research on both mechanical and biochemical solutions to particular tasks such as weeding. For example, the use of herbicides is emerging as a cost-effective way to control weeds in maize fields.

The second methodological problem involves studying mechanization as a dynamic process which captures the selective and sequential process of mechanization. Unfortunately, most mechanization research in Africa has relied on cross-sectional data to analyze whether it is economically and socially desirable to replace one complete technology set (hand hoe) with another package (such as oxen-powered or tractor mechanization) rather than a particular task--e.g., weeding--which could be performed by hand, oxen, tractor, or herbicides. I. J. Singh's (1976) research on mechanization in Tanzania provided insights into the mechanization of particular tasks in the farming system. Singh allowed his programming model to specify the lowest cost technique--hoe, oxen, or tractor--to undertake each task in the farming system.

The third problem is to capture the nonagricultural use of equipment--especially the use of oxen carting and tractors for off-farm transportation. Rarely are these important benefits quantified by researchers in Africa. The fourth problem is to capture the consumption benefits of mechanization--i.e., reduction of drudgery. These benefits may be substantial--in maize and rice processing, for example--and they should also be included in the benefit stream. The fifth problem is examining alternative energy sources.[1/] The sixth problem is designing research to gain an understanding of the organizational, logistical, and managerial problems involved in setting up and maintaining a support system for animal traction programs and tractor hire schemes. These problems are rarely addressed by academic researchers because they need to be studied over a substantial period of time (5 to 10 years), they are politically sensitive, and there are few academic rewards for this type of research.

Animal Traction

When one refers to animal-powered mechanization in Africa, the term usually refers to oxen cultivation. Various terms are used to describe cultivation with oxen such as

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[1/] For an important study of energy in the Sahelian region of West Africa, see CILSS/Club du Sahel (1978a).

animal traction, bullock cultivation, and mixed farming. Oxen are primarily used for plowing except in Senegal, Mali, and a few other countries where seeders and other implements are being used. Normally two oxen are used in plowing but six to eight oxen are common in Botswana. Although oxen are a dominant factor in subsistence farming in Asia, oxen cultivation in Africa is primarily practiced by farmers who produce export crops such as cotton and groundnuts. Horses are not common in most of sub-Saharan Africa because of the prevalence of tsetse fly (sleeping sickness). Although heavy soils restrict donkey cultivation to sandy soils, donkey cultivation is increasing in importance following the sharp rise in the price of oxen in recent years.

The rationale for animal traction is (a) the potential increase in yields through improved seed bed preparation, deeper plowing, more timely planting and weeding, and moisture conservation; (b) the potential increase in the acreage cultivated; (c) income generation through off-farm transportation; (d) the reduction in drudgery; and (e) the longer-term benefit of improving soil fertility through application of manure from the animals, deeper plowing, and plowing under crop residues. But animal traction is justified in most feasibility studies on the basis of the presumed increases in acreage and yields--both short-term considerations relative to the improvement of soil fertility.

History of Animal Traction

Animal traction was introduced by the French[1/] and British colonial services in the early 1900s with a big push occurring in the 1920s and 1930s as part of the drive to expand cotton and groundnut exports. In 1922, a mixed farming campaign was introduced by the British Colonial Service in northern Nigeria whereby farmers were given credit to purchase two oxen and equipment. The planners assumed that oxen could supplement human energy, expand the area under cultivation, and generate a cash surplus with the two cash crops--cotton and groundnuts. In 1928, research on animal traction implements was started by French researchers at the IRAT station in Bambey, Senegal.

The spread of animal traction has been closely linked to the introduction and expansion of cash crops. For example, oxen cultivation increased in the Ivory Coast from 700 to 8,000 pairs over a five-year period in the mid-1970s as part of a smallholder cotton program. Although these figures are impressive, similar "waves" of animal traction have appeared in other African countries over the past 50 years only to disappear or recede during periods of drought, changes in government policies, and the failure to provide veterinary support services. In 1981, the major concentration of animal traction was in Senegal, Mali, Botswana, and to a lesser extent in Tanzania, Uganda, and northern Nigeria.

[1/] For a history of animal traction in French-speaking countries, see Hasif (1978) and Le Moigne (1980).

As one reviews the historical experience, a major question is whether farmers selectively adopt individual implements to perform a particular task or replace one system with a totally new system of mechanization. Over the past 20 years, numerous African governments and foreign donors have been promoting a total oxen cultivation package with a tool bar and attachments such as a plow, seeder, and ridger, or tractors to replace hoe farming. A few governments include carts as part of the package. We shall examine the individual implement versus the package approach below because the widespread failure of foreign aid financed animal traction programs over the past 20 years may be tied to an approach--total animal traction package--which runs counter to the historical diffusion of mechanization not only in Africa but in high-income countries. For historical reviews of animal traction, see Kline et al. (1969); Weil (1970); Uchendu and Anthony (1975b); de Wilde et al. (1967); Migot-Adholla (1972); Okai (1975); Gaury (1977); Monnier (1975); Oluwasanmi (1975); The Gambia (1976); Zerbo and Le Moigne (1977); Sargent et al. (1981); Barrett et al. (1982); Le Moigne (1980); and T. R. Whitney (1981).

Empirical Results

Surprisingly, although animal traction has been promoted for more than 50 years in Africa, research results on the impact of animal traction at the farm level are largely impressionistic. Basic data on the yield and acreage effects of animal traction at the farm level are still inadequate in most countries because (a) research on animal traction usually takes place on experiment stations rather than on farmers' fields; (b) most research does not isolate the effects of oxen from other inputs such as the planting date, spacing, timing and quality of weeding, and fertilizers; (c) most of the research has been done by foreign researchers who are unable to provide the continuity which is needed to develop, test, and adapt implements over time; and (d) there is a lack of longitudinal data on the effect of oxen cultivation on yields, acreage, and soil fertility under differing weather conditions over time. Although there are many ex post studies of animal traction schemes, we are aware of only Andrew Ker's (1973) comparison of tractor and oxen-powered cultivation under farm level conditions in Uganda over a 12-year period.

Gemmill's (1971) study of 132 farmers in one region of Malawi, one-half of whom used hand methods and one-half oxen power, revealed that oxen power was no more timely than hand labor because neither system could be used until the arrival of the first rains. Gemmill also found that although the profitability of oxen power was low, oxen were adopted by farmers to reduce drudgery and gain prestige. Based on data collected in Uganda, Vail (1973) used linear programming to evaluate the effect of introducing Indian-type oxen cultivation and found that with appropriate training, oxen could be used to draw locally-developed mechanized seeders and weeders. Vail argued that in East Africa the

failure to develop mechanical technology appropriate for small farmers is partially a function of the overemphasis on testing individual pieces of equipment rather than research on the total farming system, including farmer preferences, managerial ability, risk, and assets.

In a major review of the literature on 27 animal traction projects or rural development projects with an animal traction component in francophone West Africa, Sargent et al. (1981) found that many studies have been undertaken by agronomists who typically estimate what they call hypothetical or "maximum potential benefits" of animal traction based on technical coefficients from experiment station trials or demonstration farms. For example, Ramond (1971) derived estimates of the maximum potential benefits from animal traction based on research on 41 demonstration farms in the groundnut basin in Senegal. Tourte et al. (1971) and Monnier (1972) showed that single-row oxen traction generated maximum potential benefits equal to about double the net farm income obtainable from donkey traction in Senegal. But Tourte et al. (1971) and Monnier (1972) did not consider the potential cash flow problems in their one-year budgets. Cash flow problems typically emerge during the first (2-4) years when farmers are learning how to handle oxen and when the acreage and yield effects are likely to be low. The studies by Monnier (1972), Tourte et al. (1971), and Ramond (1971) which estimated maximum potential benefits typically inflate the projected returns and the long-run economic profitability from animal traction that would likely be achieved under farm-level conditions. Le Moigne presented this optimistic assessment of animal traction in Francophone Africa at a recent ICRISAT conference: "Timely sowing can generate yield gains of 50 percent on groundnuts and sorghum; several mechanized weedings can increase yields of 50 percent for groundnuts and up to 175 percent for millet; and that gross margins of animal traction cultivation 'present a good picture' because they range from $286 to $476 per hectare" (1980, p. 219).

The crucial question is not what are the maximum potential benefits of animal traction on experiment stations and on demonstration farms but under farm conditions. Sargent et al. (1981) found in their review of 27 animal traction projects that most of them had not lived up to expectations because of high cost of animals and equipment, low acreage and yield effects, and the lack of reliable institutional support. The results of recent farm level research by Mettrick (1978) in the Gambia revealed that the impact of oxenization has been largely confined to the groundnut crop with a small increase in area cultivated but no increase in yields. In a recent study of 40 farmers in southeastern Mali, Whitney (1981) found that traction farmers increased their acreage by 39 percent over hoe farming but there was no change in yields.

The results of a major study of animal traction farmers in the Eastern Region of Upper Volta were reported by Barrett et al. (1982). Over the 1975-80 period, the government rural development agency has provided donkey and animal traction packages to 1,200 farmers through subsidized loans at 5.5 percent interest rates with a one-year grace period and a four-year repayment period. Based on a year-long (1978/79) farm management survey of 355 hand hoe farming households and 125 animal traction farmers (both donkey and oxen), Barrett et al. (1982) found:

1. There is a slow learning curve for farmers who are using donkeys or oxen for the first time. It takes about three to four years before a farmer knows how to use a complete package of donkey and/or oxen equipment.1/
2. The acreage and yield effects (through deeper plowing) of animal traction were modest but labor inputs per acre were reduced by as much as 20 to 25 percent. Moreover, the observed yield effects of animal traction were small compared with spectacular increases from the addition of local rock phosphate.
3. There was substantial appreciation in the value of the oxen (through weight gains) because the animals were usually purchased at three years of age and sold when they were seven or eight years old.2/ Studies of animal traction should include income from the sale of the oxen for beef because it can be an important part of the returns from oxen traction.
4. Animal traction is risky in a semi-arid environment with irregular rainfall. Although a government loan scheme was introduced to pay farmers about 90 percent of the value of animals who died because of illness, snake bites, etc., the value of the animal not covered by insurance was $150 or more than ten times the annual cash costs incurred by hoe farmers. Moreover, the government does not have a crop loan program to protect farmers from weather-induced crop failure.
5. Farmers adopting animal traction experienced major cash flow problems. Although internal rates of return on the animal traction package were positive over a ten-year period, the net returns in the first four years for oxen farmers were below the net returns before the adoption of animal traction.
6. The economics of animal traction are problematic for subsistence farmers producing primarily food crops--millet and sorghum. These findings are almost identical to the findings on oxen-drawn wheeled tool carriers on millet and sorghum farms in southern India (Binswanger, Ghodake, and Thierstein, 1980). Unless a cash crop such as cotton can be introduced into the project in eastern Upper Volta, it is questionable whether the farmers can repay their subsidized loans.

1/ The slow learning curve has important implications for the evaluation of animal traction schemes. A researcher should be cautioned against "writing off" animal traction schemes after the first 2-3 years of results.

2/ The appreciation for a pair of oxen was estimated at about $100 per year which more than covered all animal traction related costs (e.g., supplementary feeding during the dry season, veterinary supplies, etc.) in the 1978/79 survey year.

The research in Upper Volta and numerous other studies reveal that there is no single factor responsible for the repeated failure of animal traction programs. A major problem is that breaking one constraint usually induces another constraint. For example, although animal power can reduce labor inputs in land preparation, animals are not widely used for weeding. As a result, weeding often becomes the major bottleneck. Further, animals are generally underutilized since there is a shortage of well-adapted equipment available, particularly for weeding, harvesting, and threshing. Other problems plaguing animal traction programs include poor nutrition, lack of dry season fodder, disease, high mortality rates, uncertain supply of tools, problems in destumping and consolidating fields,[1/] lack of reliable markets, and failure to establish training programs for potential animal owners.[2/] Finally, government policies tend to vacillate on oxen and tractor support systems over time. For example, although Tanzania officially adopted animal mechanization as a major thrust in its Ujamaa program starting in the late 1960s, an FAO mission reported in 1975 that the government of Tanzania was, in fact, unofficially shifting its emphasis from ox power to "power mechanization as an instrument of change and modernization of agriculture" (FAO, 1975b). Likewise, animal traction expanded rapidly in northern Benin with FAO and Peace Corps assistance in the early 1970s only to stagnate in the late 1970s as government policies changed and the crucial institutions--credit and veterinary services--lost their effectiveness.

The costs of oxen, donkeys, and equipment packages are rising and the profitability of total packages of animal traction equipment is in question in much of Africa. For example, in 1977 in West Africa, a donkey traction package (donkey, western hoe, supereco seeder, and donkey cart) cost about $500 while an oxen traction package was about $1,000 (f.o.b. Dakar) for two oxen, arara tool bar, ox cart, and supereco seeder (Zerbo and Le Moigne, 1977, p. 281). In 1980 in eastern Upper Volta, the cost of a good three year old pair of oxen was about $350, while a donkey cost about $75 (Barrett et al., 1982).

The presence or absence of a cash crop is a central determinant of farm level profitability of animal traction. This finding is illustrated by research in northern Nigeria (Tiffen, 1976), the groundnut basin in Senegal, the cotton zones in southern Mali, the Ivory Coast, and in northern Cameroun. For example, in a World Bank financed cotton project in the Ivory Coast, oxen cultivation generated a return of 500 CFAF ($2.50) per day of

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[1/] The Experimental Units in Senegal have addressed these problems by giving incentives to farmers to destump and consolidate their fields (see ISRA, 1977; Faye and Niang, 1977).

[2/] These problems are covered in the following: Venema (1978); Schulman (1979); Weil (1970, 1980); and Goe and McDowell (1980).

family labor in 1980 which was 40 percent higher than the return to hand cultivation of cotton.

In summary, there is a range of technical, economic, and logistical constraints on the spread of total packages of animal traction in Africa. Under present factor and product price ratios and the token research underway on improving implements, it appears that animal traction will be restricted to "pockets of cash crop production" in Africa just as tractors in India have been primarily restricted to large farmers in the Punjab (Binswanger, 1978). African governments and donors should consider examining the economic history of high-income countries where mechanization historically has proceeded by replacing one tool or implement with another.[1/] We are of the conviction that complete animal traction packages cannot serve as an engine of growth of agriculture in Africa. Selective mechanization--farmers replacing one implement at a time--should be facilitated and major attention should be directed to improved agronomic practices which can complement animal traction.

Tractor Mechanization

Turning to tractor mechanization, most African governments started to import tractors in the 1950s and 1960s as part of large-scale agricultural schemes. Still, the number of tractors in Africa in 1981 is small and the number in operation at any one time is insignificant. For example, Otieno, Muchiri, and Johnston (1975) report that only about 40 percent of the tractors of private contractors in Kenya are operational at any one time. For overviews of tractor mechanization, see Hall (1968); Kline, Green et al. (1969); Gemmill and Eicher (1973); Westley and Johnston (1975); Clayton (1975); ILO (1976); Winch (1976); Muchiri (1979); Hunt (1975b); Monnier (1975); Purvis (1968b); Kolawole (1972, 1974); Kinsey (1978); Nweke (1979); and Wuyts (1981).

Tractor hire services--both government and private--are theoretically attractive because of their perceived ability to spread the fixed costs of the tractor and equipment over a large number of small farmers. Although the demand for tractor hire services has been artificially increased by government subsidies, Gemmill and Eicher (1973) report that most government tractor hire schemes in Africa have not been successful because of high operation costs on fields which are small, scattered, and irregular in shape. Purvis (1968b) and Kolawole's (1972) studies of government tractor hire schemes in western Nigeria revealed that there was little financial advantage to participating farmers because of

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[1/] Paul David (1975) has shown that there was a 15-year time lag between the availability of the reaper for wheat harvesting in the western part of the U.S. in 1840 and the widespread diffusion of the reaper starting in the mid-1850s. The diffusion of the reaper was "held back" until there was a large increase in rural wage rates over the 1840-1855 period.

frequent breakdowns and a shortage of operators resulting in delayed planting. A survey of 907 tractors in a government tractor hire scheme in northern Ghana in 1968 revealed that 78 percent of the tractors were broken and waiting repairs (Kline et al., 1969). In Uganda, tractors in the government's tractor hire scheme were being used only 450 hours per year after 10 years of operation of the scheme (Singh, 1976).

Numerous studies of the economics of private tractor ownership and government tractor hire schemes show that while government subsidies help make mechanization financially rewarding to individual farmers, the schemes generally have high social costs in terms of required government subsidies and, in some cases, the displacement of tenants. For example, Spencer and Byerlee (1976) report that 85 percent of the cost of the government tractor hire scheme in Sierra Leone was subsidized in the mid-1970s. In Ethiopia, J. M. Cohen (1980a) reports that farmers in the CADU rural development project received duty-free importation of machinery and spare parts, fuel-tax waivers, and subsidized credit at 7 percent interest rates. Ellis' survey (1972) of mechanization in southern Ethiopia revealed that although both the financial and economic returns to tractor mechanization were low, large land owners purchased tractors, evicted tenants, and reduced their hired labor force in an attempt to avoid the problems involved in supervising a large number of casual laborers. It follows that mechanization programs should be evaluated on the basis of (a) financial returns to farmers (the main concern of engineers), (b) economic returns to society (taking taxes and subsidies into account), and (c) the social impact in terms of employment and income distribution.

The employment and income distribution effects of tractor mechanization schemes started to appear in the literature in the 1970s. Winch's (1976) study of rice production in northern Ghana provides evidence on the financial and economic returns to alternative systems of mechanization. In 1973, Winch collected daily input/output data for each farming task on 161 rice farms in northern Ghana; the farms were stratified into six farming systems, five of which relied on tractors and one on oxen. One of Winch's main findings was that government taxes and subsidies have greatly distorted the relative profitability of the different rice production systems. For example, of the five production systems relying on tractor mechanization, the largest, most capital-intensive of the five systems was found to be the most profitable to farmers, but least profitable to society when economic costs (taxes and subsidies) were taken into account. Winch concluded that only some tasks such as plowing could be performed with tractors at acceptable financial and economic returns. Winch also found that combine harvesting dramatically reduced harvesting labor from 142 to 10 man-hours per acre. Although large farmers in Ghana found combine harvesting extremely profitable, the costs to society--in terms of

subsidies--and reduced employment opportunities were high. Shepherd (1981), a sociologist, analyzed agricultural development projects in northern Ghana, including the rice farming scheme in the Tamale area studied by Winch, and contends that "the benefits of state investment in agriculture, at least in the north, have accrued largely to capitalist (meaning large farmers) and part-time or absentee farmers" (1981, pp. 187-188). See also, Goody (1980).

Mechanization is a major policy issue in the Sudan--a country with only 18 million people, two-thirds the land area of India (with 670 million people) and few problems of unemployment.[1/] Since the clay soils throughout the country can be tilled by hand only with great difficulty, there is a technical case for tractor land preparation. Mechanized farming was started in the Sudan in 1945 and it spread rapidly in the 1960s with the establishment of the Government's Mechanized Farming Corporation. Mechanized farming was highly subsidized in 1981 and the financial returns to farmers were reported to be high. For example, the ILO (1976) estimated that subsidized mechanized farms of 1,500 acres earned $5,000 to $6,000 gross income before taxes. This is 10 to 20 times larger than that of farmers who cultivate small farms with hoes. The ILO report alledged that there are serious problems with wind erosion and loss of soil fertility on the large government and private mechanized sorghum farms. Research is needed on the economic cost of subsidized mechanization and the technical (e.g., erosion problems) and social impact of subsidized mechanization.

I. J. Singh's (1976) programming model of 290 farming households in the main grain, cotton, and groundnut growing regions bordering Lake Victoria (Sukumaland) in Tanzania merits careful scrutiny. Singh generated data on hoe, oxen, and tractor cultivation under traditional and improved packages. Singh's model revealed that hoe cultivation is the most economically efficient method of cultivation for 78 percent of the farmers--i.e., farms with less than six hectares; and that hoe cultivation supplemented by oxen cultivation is the most efficient method for the other 22 percent of the holdings (farms with more than six hectares). Singh observed that many countries in Africa are in a transition period from hand to oxen and tractor mechanization and that as a result we should expect some farming tasks in the 1980s can be most efficiently performed by hand while others could be performed by oxen or tractors. In a study in the main maize growing area in southern Zambia, Kinsey (1978) also found that there was no one optimal choice of technology which could satisfy the large commercial (mostly European) farmers and the small African farmers. Using data collected during the 1970/71 growing season,

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[1/] In 1978, the government raised minimum wages for both men and women in rural areas from 16 to 28 Sudanese pounds per month; an example of how a government policy promotes the substitution of capital for labor.

Kinsey's LP analysis revealed that there were numerous conflicts between the criterion of private profitability of commercial farmers using tractors and tractor hire services and the small farmers using hoes and oxen. Kinsey concluded that subsidies promoting tractor mechanization should be discontinued and that research attention should shift to developing technologies which were intermediate between tractor mechanization and hoe cultivation.

Binswanger's (1978) careful review of tractor mechanization studies in India, Pakistan, and Nepal is an invaluable reference for researchers in Africa. Binswanger found that (except in special cases) there were no significant increases in yield, cropping intensity, or timeliness arising from the replacement of bullocks with a tractor. He further added that "at best such benefits may exist but they are so small that they cannot be detected and statistically supported, even with massive survey research efforts." Binswanger found that most of the mechanization studies which he reviewed overestimated both the private and social benefits which arise from the agricultural use of tractors. Binswanger recommended that subsidies on tractors in the three countries studied be removed and speculated that with the quantum jump in fuel prices since 1973, tractor mechanization would be feasible in the future only under conditions of rapidly rising wage rates and increased prices of bullock implements.

Synthesis

Mechanization--especially total tractor mechanization of all farming tasks--has wide support throughout Africa; it is a dream of many politicians, donors, and engineers who want to "modernize" African agriculture. For example, President Nyerere is quoted by W. E. S. Smith (1971) as saying "We are using hoes. If two million farmers in Tanzania could jump from hoe to the oxen plough, it would be a revolution. It would double our living standard, triple our product. This is the kind of thing China is doing." Our review has shown, however, that both animal and tractor mechanization are plagued with technical, economic, and institutional problems. We believe that tractors will remain as a minor power source in most countries in sub-Saharan Africa in the 1980s because of the post-1973 quantum jump in fuel prices and the myriad of technical problems (low use rates and lack of maintenance). But it will be financially profitable for farmers and economically profitable for governments increasingly to carry out some farming tasks such as land preparation with tractors as rural wage rates rise. For a few countries such as the Sudan, tractor mechanization of all major tasks--land preparation, planting, and harvesting--will probably be desirable from a national policy perspective in the 1980s and 1990s. As a broad generalization, however, hand and oxen power will undoubtedly remain the major power sources in the 1980s and should receive the bulk of research support.

Research on agricultural mechanization has been modest, ad hoc, and usually not conducted under actual farming conditions. For the 1950-80 period, the focus of much of the engineering research was on testing imported tractors and equipment. There is a need to shift the emphasis to on-farm research as an integral part of research by multidisciplinary teams on farming systems in specific locations. A promising start is underway at the Department of Agricultural Engineering at the University of Nairobi where a multidisciplinary research team under the leadership of G. Muchiri (1979) is developing tillage equipment for dryland farming with emphasis on timeliness in planting and weeding and preservation of the soil from wind and water erosion.[1/] There are numerous experiments with small tractors underway in Africa. For example, small Japanese walking tractors have been tested and rejected in northern Nigeria, the Swazi tractor has been tested in Mali (Traore and Toure, 1978), and 22 hp French tractors are being tested in cotton projects in the Ivory Coast and in southern Mali. This experimentation should continue.

Agricultural Extension

Over the past 20 years, most sub-Saharan African countries have expanded the size of their extension staffs but the ratio of agents to farmers varies widely within and between countries.[2/] In their worldwide review of research and extension systems, Boyce and Evenson (1975) showed that expenditures on agricultural extension in Africa in 1974 were 2.2 percent of the value of agricultural production, which was more than two times the percentage of any other region. Nevertheless, extension programs in Africa have been plagued by the same problems affecting extension throughout the developing world, including too few agents (in some countries), low pay, poor training, insufficient logistical support, dilution of efforts, low status, lack of effective linkages with research units, and inappropriate technical packages. For overviews of the problems of extension services in developing countries, see Benor and Harrison (1977) and Stavis (1979).[3/] De Wilde, et al. (1967), E. Hopkins (1974), Lele (1976), Chambers (1974), De Vries (1976, 1978), and Leonard (1977) review extension services in Africa.

[1/] See Westley and Johnston (1975) for the proceedings of a major workshop on farm equipment innovations in Kenya.

[2/] The various field agents which together form the extension service often come from parastatals and several governmental departments and agencies, including agriculture, livestock, education, fisheries, forestry, health, and community development. The activities of these field agents are rarely coordinated and they often present conflicting messages to rural households. Our discussion will focus on agricultural extension agents.

[3/] Stavis argues that extension agents in developing countries frequently are only a marginal source of information for farmers, that extension services are directed by political priorities, and that by themselves they cannot do much to help the small farmer.

Historical Perspective

Agricultural extension services were established throughout Africa during the colonial period. During this period, extension activities were primarily oriented toward promoting the production of export crops. In many cases, extension contact with African farmers consisted of little more than issuing improved seeds (Moris, 1973). To the extent extension agents provided advice to Africans they focused almost exclusively on progressive farmers. Extension agents in most countries had conflicting roles as the field representatives of colonial governments. They often collected taxes and were responsible for enforcing rules regarding land conservation, prohibitions on growing certain crops, and facilitating the recruitment of "forced" labor for roads, mines, and plantations. As a result, the colonial period left a legacy of distrust for government extension agents which continues to plague the efforts of current programs.

During the postindependence period in the 1960s, the focus of extension services shifted from coercion to persuasion but the tendency to concentrate on export commodities, to formulate extension advice with little regard for farmer circumstances, and the bias in favor of progressive farmers, has continued to dominate extension in most countries. Moreover, over the past 20 years, most extension services throughout Africa have been understaffed, ill-equipped, and under-trained relative to their counterparts in Asia or Latin America. One of the frequent recommendations of international agencies during the 1960s was to step up training programs to greatly increase the number of agents and improve the extension/farmer ratio (e.g., FAO, 1966). But the effectiveness of extension services, even in countries such as Kenya which has one of the lowest farmer/agent ratios, has continued to be limited. Many extension services in Africa were written-off by policy makers and donor agencies starting in the 1970s. This skepticism continues today. For example, the World Bank (1981b) has argued that extension programs in Africa suffer from organizational weaknesses characteristic of almost all public sector activities plus special problems associated with transportation, inadequate operating funds, no message to extend, and a lack of women agents. Furthermore, extension agents have frequently been characterized as lazy and irresponsible: they have a relaxed pace, spend few hours visiting farms, and tend to concentrate on accessible villages (Chambers, 1974).

The poor performance of extension services in promoting change stimulated numerous empirical studies beginning in the mid-1960s on (1) the effectiveness of alternative extension approaches and (2) the relationship between extension and the diffusion of innovations.

Alternative Extension Approaches

There are several ways to distinguish among extension approaches. A major distinction is between general (national) services and those which emphasize a special commodity or interventions such as credit. In most general extension services in Africa, little control is used to see that farmers follow recommended practices. It is common for extension services to play a role in provision of improved inputs since the majority of African governments have monopoly control over fertilizers, improved seeds, and herbicides (World Bank, 1981b). Many general extension services are responsible for collecting agricultural statistics and several administer seed multiplication programs based on contract farmers.

In an attempt to supplement the efforts of generalized extension services, many governments have established farmer training centers (FTC). Another alternative to generalized extension services is the specialized parastatal agencies which integrate the supply of inputs, extension advice, and distribution of the product. Specialized parastatals generally have been established to promote increased production of a cash crop such as cotton, tea, or coffee, although in some countries parastatals have been organized on a regional rather than a commodity basis. Also, in some countries, private sector corporations--such as the British-American Tobacco Company--provide integrated input supply-extension services. We now turn to an overview of studies which have evaluated the effectiveness of alternative extension programs.

National Extension Programs

Following a pattern established under colonial governments, most extension services are oriented toward technical problems and pay little attention to farm management issues or to the social constraints faced by rural households. Belshaw (1968), for example, argued that the agenda of extension agents is determined by technical and administration considerations and that a failure to understand the socioeconomic structure of smallholder farming is a major reason why resources invested in extension services generally have a low return. Watts (1969) similarly argued that extension advice is too oriented toward maximizing agricultural production and gives little consideration to the overall income and welfare of farming households.

Lele (1976) contends that the underlying assumption of most extension programs in Africa has been that the main cause of farmer resistance to new technologies is psychological and that farmers can only be convinced of the value of extension advice through personal contact.[1/] Philip Mbithi (1973), a Kenyan rural sociologist, has labeled

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[1/] Lele also contends that since extension agents generally are young and receive little training, farmers often have known more than the extension agents.

this approach to extension a "message model" which is based on (1) the assumption that knowledge and the desire to change always originate in the research and extension system, (2) a tendency to promote selected packages, or messages, at different times with no logical continuity between messages, and (3) a tendency to stereotype farmers and to group them in homogeneous masses. Another rural sociologist with extensive experience in East Africa, J. R. Moris (1973), has called the dominant extension model a "hub-and-wheel system" because a "center-post" person generally takes responsibility for all phases of extension activities in a given area. This person supervises several field agents who have little education or training. Moris claims that many of the success stories of the colonial period can be traced to the skill and perseverance of individuals who were able to fill the center-post role.

During the 1970s, several researchers carried out assessments of national extension systems in order to identify ways of making general extension services more effective. The extension system in Kenya is one of the best studied programs in Africa. Researchers at the IDS of the University of Nairobi played an active role in evaluating approaches for improving extension as part of the Special Rural Development Program. Political scientist, David Leonard (1977), presented a valuable overview of the problems faced in establishing and supervising field agents in Kenya. Additional evaluations of extension in Kenya were presented in Leonard (1973); Heyer, Maitha, and Senga (1976); University of Nairobi (1975); and Chambers (1974).

The two major extension approaches which have been used in Nigeria are the Lugardian Extension System, which is based on commodity-specific extension programs and top-down control, and the College Extension System (CES), which is based on the U.S. land grant model and gives greater emphasis to personal contact between farmers and extension agents and promotion of a range of recommended practices generated by national research institutions. Olayide and Ogunfiditimi (1980) recommend that emphasis be given to the CES approach on the basis of a review of several rural development programs during the 1972-76 period. Some of the factors found to affect the success of the CES approach were: fewer procedural complexities than the vertically integrated approach, good two-way communication between farmers and agents, and a system for rewarding hard work. The main modifications they suggested for improving extension services in Nigeria include: (1) increasing small farmer participation, (2) recognizing class structures and different attitudes among farmers, (3) more effective use of farmer groups, and (4) more decentralized administration.

Atsu (1974) reviewed approaches to extension in Ghana with an emphasis on the Focus and Concentrate program. The Focus and Concentrate program emerged in 1968 in response to the shortage of personnel and funds. The program was based on focusing

resources on progressive farmers in a limited area. Atsu shows that the proposed package had little effect on yields and net returns and the program had little spread-effect to other farmers. The Focus and Concentrate approach proved to be bankrupt and has few supporters in Africa.

In a review of agricultural extension approaches in Botswana, Lever (1970) pointed out that the general extension service primarily operated through personal visits and demonstrations to farmers. Because of this, the cost per farmer was high and there was a tendency to work with the better farmers. Lever argued that the major impact of the extension service has come through providing access to ox-drawn implements rather than through advice on farming practices and that this has primarily benefited farmers with a desire and financial ability to adopt animal traction. Lever concluded that the benefits of extension services in Botswana did not cover their cost in several parts of the country.

M. Schulz (1976) reviewed the organization of extension services in Ethiopia immediately preceding and following the socialist revolution in 1974. The extension service in Ethiopia historically had been understaffed relative to most other African countries. For example, in 1968 there were around 500 field level staff compared to over 5,000 in Kenya which had one-half the population. In 1971, the Extension Program and Implementation Division (EPID) was established. EPID was based on two principles: a well-defined technical package based on fertilizer, improved seeds and credit, and a program for phasing in extension activities in conjunction with farm surveys over a four-year period in each new area where extension services were to be established. For additional assessments of extension in Ethiopia under the CADU, WADU and the various minimum package programs, see Tecle (1975) and J. M. Cohen (1975).

Farmer Training Centers

Farmer training centers (FTC) have been established in several countries to supplement the efforts of national extension programs. Most FTCs offer short-term courses on particular technical subjects. While the idea of residential farmer training was tried as early as 1910 in Uganda and during the 1930s in Kenya, the big push to establish training programs came in the 1960s when centers were established in several countries. Barwell (1975) presents a valuable overview of the issues in establishing farmer training centers based on the experiences of nine southern African countries.[1/]

The FTC program in Zambia was reviewed by Honeybone and Marter (1975). They found that the short-term training program (one or two weeks) had little effect and, to the extent there was a change in farmers' performance, training tended to increase

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[1/] Ethiopia, Uganda, Kenya, Tanzania, Zambia, Malawi, Swaziland, Lesotho, Botswana.

disparities between less and more prosperous households. They criticized the technical bias of the training course and noted that the course failed to provide advice on the main staples other than maize (millet, sorghum, and cassava). They did note, however, that most trainers felt that contact with farmers was more effective and easier in the controlled environment of the training centers. Honeybone and Marter recommended a move toward an extension system based on village groups.

Commodity Parastatals

One of the most effective alternatives to general extension programs has been the commodity-specific parastatal and private companies which integrate extension with input supply and marketing. While these agencies are invariably organized on the basis of a lead commercial crop, many advocates of this approach contend there usually are spread-effects to other crops. The commodity-specific parastatals are common in Francophone Africa.

The rapid expansion of tea production by small farmers in Kenya in the 1960s and 1970s illustrates the effectiveness of extension programs administered by specialized commodity agencies. Etherington (1971) showed how institutional innovations by the Kenya Tea Development Authority (KTDA) were crucial to the spread of tea production and the growth of the vertically integrated tea industry with 18,000 smallholders. First, the propagation of tea stumps in government tea nurseries enabled new varieties to be rapidly multiplied for small farmers. Second, the KTDA built "tea roads" throughout tea-producing areas to ensure the delivery of inputs and the rapid evacuation to tea processing plants. Finally, the Tea Authority built processing plants because tea leaves must be processed within a few hours after they are plucked and a single tea plant could serve several thousand smallholders.[1/]

The activities of the CFDT[2/] in Mali, Upper Volta, and other francophone countries is often cited as another example of a successful commodity-based extension and input supply program. The CFDT has concentrated on cotton and the efficiency of its operations has resulted in a rapid expansion of cotton acreage in the Sudanian zone of West Africa (de Wilde et al., 1967). The major criticism of specialized commodity programs is that they have often had little impact on other crops. For an assessment of the CFDT program in Mali, see de Wilde et al. (1967, Vol. 2).

[1/] Steeves (1978) argued that while the KTDA program may have initially enabled widespread access to tea growing, during the 1963-68 period the investment required to start growing tea increased by 400 percent. As a result, only more prosperous families could begin growing tea and the KTDA program has led to increased inequality in Kenya.

[2/] Compagnie Francaise pour le Developpement des Fibres Textiles.

Training and Visit

The Training and Visit approach (T-V) developed by Daniel Benor in India has received strong endorsement by the World Bank and other donor agencies as a system for improving extension services in low-income countries (Benor and Harrison, 1977). In the T-V approach, village extension workers (VEW) carry out an intensive series of weekly or biweekly visits with farmers on a fixed schedule.[1/] While initial results of the T-V approach in India and Turkey appear promising, it is unlikely the approach can be applied in Africa without major modifications. The required level of highly trained manpower, not to mention the transport and communication infrastructure required for the proposed visit and supervision schedule, are beyond the reach of all African countries. Moreover, Benor and Harrison propose the unification of extension services under the T-V approach but this is inconsistent with the historical record in Africa which shows that commodity parastatals have consistently out performed generalized extension services.

Diffusion Studies

Studies of the diffusion of agricultural innovations were popular in many developing countries in the "Green Revolution Decade" of the 1960s. Innovation was thought to be the best single indicator of the multi-faceted dimension called modernization, the individual-level equivalent of development (Rogers, 1976b). Research on the diffusion of new technologies was justified because it was assumed that technology was the prime mover in development. In most diffusion studies, farmers were interviewed in one-shot interviews in order to trace the acceptance of a particular innovation. Correlation analysis was usually used to assess the correlation between attributes of individuals such as age and education and the spread of the innovations. Research on the correlation between extension and diffusion of technology also was carried out because it was thought that information on the pattern of diffusion could be of direct help to extension workers in speeding up the adoption of new technology.

One of the main contributions of diffusion studies has been the evidence provided on the relationship between extension services and patterns of adoption of new technology. Diffusion studies in the mid-1970s in Ethiopia, Kenya, and Tanzania provided evidence that larger farmers often capture a disproportionate share of the time of extension agents and the benefits of technical change. In the early 1970s, for example, a large group of

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[1/] The VEWs are closely supervised by agricultural extension officers who in turn are supervised by sub-division extension officers. At the sub-division level, there is a team of subject matter specialists who assist in formulating the extension message for that period. Each VEW receives one day of in-service training each week and is expected to serve around 500 to 800 farm families. The hierarchial system of supervision in the T-V approach can extend through as many as 6 to 7 levels before reaching the headquarters of a zone or region.

Swedish experts assisted in launching an integrated rural development program in the Chilalo District in Ethiopia. Within a few years, dramatic increases in wheat output were reported in the project but a Ministry of Agriculture report on the effects of mechanization in the project area was suppressed by the government and never published. Ellis (1972), J. Cohen (1975), Tecle (1975), and Akilu (1980) later revealed that landlords were receiving a disproportionate share of the time of extension agents and that, in fact, tenants were being displaced as their landlords adopted mechanization.

As part of the Special Rural Development Program in Kenya, Ascroft, et al. (1973) conducted a survey of the impact of extension services in Tetu District. They divided farmers into several groups on the basis of their progressiveness. The progressiveness index was based on the number of recommended practices adopted and the time at which they were adopted. Their survey showed that more progressive farmers tended to have larger farms, better access to extension, and were more likely to have a fully titled farm. For example, they found that agricultural extension officers visited 100 percent of the most progressive farmers but only 41 percent of the laggards. A surprising 37 percent of the laggards received no visits from any extension officers compared to only 8 percent of the population as a whole. But Ascroft et al. point out that 81 percent of the progressive farmers initiated contact with agricultural extension officers while only 17 percent of the laggards did and concluded that the imbalance in extension contact could at least partially be attributed to farmer demand.[1/]

In Tanzania, de Vries (1978) surveyed 344 farmers in 43 Ujamaa villages in the Iringa region and found that the recommendations of the extension agents were geared to a high degree to large farmers. Similar findings on the relationship between extension and patterns of technical change have been reported by Leonard (1977); E. Hopkins (1974); Keregero, de Vries, and Bartlett (1976); and Schulz (1976).

An important exception to the generalization that research and extension programs disproportionally help larger and richer farmers is found in the diffusion of hybrid maize in Kenya. Gerhart (1975) and Heyer and Waweru (1976) reported that whereas the bulk of agricultural research expenditures in Kenya has been geared to export crops and to large farmers, research on maize has developed varieties for different ecological zones which have been quickly adopted by large and small farmers throughout the country. For example, during the 1960s, the area in hybrid maize grew from 400 acres to over 800,000

[1/] The study by Ascroft, et al. also provided support for the effectiveness of FTC in Kenya. Nearly half (48 percent) of the progressive farmers and only 5 percent of the laggards had attended a FTC. Moreover, in an experiment to see whether extension services can effectively concentrate on average farmers rather than progressive farmers, they found that of 798 non-adopters of hybrid maize who attended a three-day training program, 97 percent began planting hybrid maize.

acres and it "proceeded at a rate somewhat more rapid than hybrid corn was adopted by American farmers thirty years earlier" (Gerhart, 1975). Gerhart observed that the new hybrid varieties were first adopted by large farmers followed by the bulk of small farmers after a few years.[1/] Harrison (1970) contends that the rapid adoption of hybrid corn among small farmers in Kenya can be largely explained by (1) an active breeding and agronomic research program, (2) close ties between research and extension services, (3) liaison between breeders and firms to multiply and distribute seeds, (4) use of demonstration plots as a means of convincing farmers, and (5) the technology was divisible, maize seed could be purchased in small units (10 kilos) by almost any farmer. This points up the need for farming systems research in specific zones and the importance of taking into account the relationships between research, extension, input supply, and marketing in designing successful technical change programs.

In summary, diffusion studies have provided valuable information on the influence of institutions, particularly extension services, on the adoption of innovations and farmer assessment of new technology. But during the 1970s, a number of researchers became disillusioned with diffusion studies. Roling (1970), for example, argued that variables such as age, education of the farmers, and the ratio of extension workers to farmers were unable to explain the behavior of non-innovators. Rogers (1976b) surveyed 1,800 diffusion studies in developing countries and concluded that the studies were too narrowly conceived, they ignored important structural barriers to change, and they did not study non-innovators. We feel that adoption studies are a vital part of farming systems research but agree with Rogers that there is a need for more research on communication as a process, more longitudinal research on innovations, and more emphasis on field experiments and political variables.

Farming Systems Research (FSR)

Several experienced researchers (Belshaw and Hall, 1972; Palmer-Jones, 1977a; and Collinson, 1981) feel that much of the micro-economic information collected in the sixties and seventies was of limited relevance to small farmers in Africa for the following reasons:

(1) most studies failed to address the information needs of small farmers in the context of their goals and management strategies;

(2) there was a large gap between the values, interests, and education of researchers and extension agents on the one hand, and small farmers on the other;

[1/] Gerhart found that agroclimatic zone was the single most important factor explaining the adoption of maize, followed by the risk associated with different cropping patterns and access to credit.

(3) many researchers studied only one or at most a few enterprises;

(4) most studies failed to take into account the impact of social and political institutions on household decision making; and

(5) research findings rarely were disseminated in a form usable by farmers.

In light of these difficulties, numerous researchers recommended that more research should be pursued within a cropping and farming systems framework (CGIAR, 1978; Norman, 1980; Gilbert, Norman, and Winch, 1980; Byerlee, Collinson et al., 1980; Collinson, 1981, 1982).

The primary goal of farming systems research (FSR) is to design research programs which are holistic, interdisciplinary, and cost-effective in generating technology which is appropriate to the production and consumption goals of rural households in specific micro-environments. The focus on a systems approach to the study of farming systems is a key feature which distinguishes FSR from old style farm management research.[1/] However, there are more similarities than differences between farm management research and FSR. The ability of systems scientists to model the complex interactions within cropping systems and between cropping and livestock subsystems is one of the potential advantages of FSR.

Research on farming systems accepts the following as a point of departure: (1) FSR is a complement to and not a substitute for strong national commodity research programs; (2) FSR should focus on the rural household as a production and consumption unit; (3) farming practices that have evolved over generations are assumed to be well-honed and adapted to the goals of rural households as joint consumption/production units; (4) both farm and non-farm activities should be analyzed in FSR; (5) the farmer should be an active partner in carrying out trials of new varieties and agronomic practices; and (6) in most national research systems there is a need to increase farm level experimentation by both FSR teams and commodity researchers.

Four or five basic steps are generally recommended in carrying out FSR: (1) conduct informal (reconnaissance) surveys of farmers to identify their problems and constraints on achieving their multiple goals; (2) conduct on-farm trials of promising techniques and varieties; (3) analyze results of farm trials in several locations and evaluate the economics of promising interventions; (4) assess the experiences of farmers

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[1/] The problem of identifying groups of farms which are sufficiently homogeneous to serve as recommendation domains continues to be one of the main challenges facing FSR researchers. The extent to which small farmers are homogeneous and can therefore be treated as a group has been long debated (e.g., Hill, 1968; Collinson, 1972; Heyer, 1981). Another major problem is the issue of sufficient conditions for aggregation (e.g., Odero-Ogwel, 1982, and Clayton, 1973). For discussion of these issues in the context of FSR, see Crawford (1982) and Byerlee, Collinson et al. (1980).

in using the recommended practices and varieties; and (5) extend promising interventions to a broader group of farmers (Norman, 1980; Byerlee, Collinson et al., 1980).

In the 1970s, farming systems research was initiated in several International Agricultural Research Centers (IARCs) including IRRI in the Philippines, CIAT in Colombia, IITA in Nigeria, ICRISAT in India, and CIMMYT[1/] in Mexico. FSR programs to date have stressed cropping systems research and the role of two key disciplines--agronomy and economics in such research. For example, the CIMMYT FSR manual[2/] stresses the role of agronomists and economists in informal surveys (Byerlee, Collinson et al., 1980). Much of the FSR by the IARCs has focused on cropping subsystems and the production decisions of farmers. Little attention has been given to livestock, marketing, and off-farm employment. Norman and Palmer-Jones (1977a), for example, criticized cropping systems research for overemphasizing production technology and failing to take into account the "human element" of farming systems. The "human element" is defined to include exogenous factors such as the social environment, factors outside the control of an individual farmer, and endogenous factors such as the goals of farmers. A CGIAR[3/] team led by John Dillon, an Australian agricultural economist, undertook an assessment of the research programs in four IARCs (CIAT, IITA, ICRISAT, and IRRI) and concluded that "FSR is both a valid and essential activity for the IARC system" (CGIAR, 1978, p. 59). The Dillon team urged the IARCs to undertake FSR and devote more attention to crop and livestock interactions, on-farm trials, and village and socioeconomic studies (CGIAR, 1978).

Farming systems research is now expanding rapidly in Africa. Several conferences were turning points in the evolution of FSR. First, a conference on intercropping in Tanzania revealed a need to study indigenous farm practices such as intercropping rather than automatically promoting western practices such as sole cropping and row cropping (Monyo et al., 1976). Second, a conceptual framework for FSR was spelled out at a

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[1/] Although CIMMYT does not have a formal FSR department or FSR program, CIMMYT researchers (emphasizing maize and wheat research) are using an FSR approach in collaboration with national agricultural services in Latin America and Africa (Collinson, 1982).

[2/] Although the words FSR do not appear in the title of the manual "Planning Technologies Appropriate to Farmers," the manual is the primary reference for many FSR teams throughout the world.

[3/] The Consultative Group on International Agricultural Research (CGIAR) is an informal association of governments, international and regional organizations, and private foundations which mobilizes financial support for the network of 13 international agricultural research centers. The Secretariat of CGIAR is located in the World Bank in Washington.

conference at the Institut d'Economie Rurale in Mali (Institut d'Economie Rurale, 1977). Third, a symposium on the Experimental Unit approach in Senegal highlighted the importance of farm level experimentation (ISRA, 1977). Finally, a conference on land use held in Ouagadougou represented a major synthesis of social, economic, geographical, and technical perspectives on farm level studies in Africa (ORSTOM, 1979). Numerous papers in the ORSTOM conference proceedings directly or indirectly endorsed a systems approach to agricultural research. By 1981, almost half the countries in Africa had launched FSR projects.

While FSR recently has received some attention by African policy makers and a groundswell of backing by foreign aid donors, FSR is not a new approach to agricultural research in Africa. There is an invisible literature on FSR in Africa which can provide a perspective on current FSR programs. A major research effort on farming systems was reported in Arnold's (1976) indispensible book Agricultural Research for Development. Arnold analyzed the experience of the Cotton Research Corporation (then the Empire Cotton Growing Corporation) in setting up a new research station at Namulonge in Uganda. The Namulonge station was charged with developing a cotton research program for Uganda by drawing on the cotton breeding work in Trinidad and the practical research on cotton at the Barberton Research Station in South Africa. Three important insights can be gleaned from the Namulonge experience for FSR today. First, a decision was taken at the Namulonge research station to evaluate complete farming systems in a multi-year context (five years), including crop rotations, instead of relying on conventional test plot research. This decision was later to dominate the research program of the station and make a major contribution to research on tropical agriculture. Second, Arnold reported that "Devising a highly productive farming system on the ancient Uganda soils took, not five years, but fifteen" (p. vii). The 15-year period should be kept in mind by present-day advocates of FSR and donors who want FSR results in three to five years. Third, Arnold reported "Soil science had only a small place in the original plans" but that "When it became clear that soil fertility was at the heart of the problem of raising productivity . . . the Ministry of Overseas Development was enlisted to increase the soil fertility research program." In summary, the CGIAR (1978) evaluation of FSR in IARCs which urged the international centers to move more research off the stations was simply reinforcing what had been learned in Uganda in the 1950s--that research on farms is not a luxury but is central in shaping the research programs of experiment stations and national research systems.

Other examples of FSR in Africa which pre-date contemporary FSR programs include a number of studies conducted by multi-disciplinary teams in the 1960s. Foremost of these is the Uboma study in eastern Nigeria in which a socioeconomic and nutritional

survey was carried out in Uboma Village in 1964, followed by experimentation in agronomy, health, nutrition, and livestock. Uboma was chosen as a laboratory for the densely populated Oil Palm Belt. Shell International Petroleum helped finance the Uboma work. The Uboma study is reported in Oluwasanmi et al. (1966).

Another FSR pilot program which pre-dates contemporary FSR is the Experimental Unit program in Senegal. (See ISRA, 1977; Faye and Niang, 1977; and Benoit-Cattin, 1977a.) The Senegalese research organization (ISRA) established an Experimental Unit in a small number of pilot villages in an experimental zone in the groundnut basin. The purpose of the Experimental Unit program was to develop technological packages with an emphasis on increasing yields without degrading soil resources. The first two phases in the Experimental Units--(a) analytical and socioeconomic studies, and (b) agronomic experimentation--were pursued by researchers of different disciplines and commodity specialists. The unique aspect of the Experimental Unit approach came in the third phase when potential modifications in existing farming systems were tested by farmers in the villages in the Experimental Unit (zone). Testing was first done under strict research supervision with the best farmers.[1/] Successful innovations were then presented as a total package for demonstration and pre-extension in each agro-ecological zone in the Experimental Unit (zone). During later phases of testing, farmers were given managerial responsibility so that the end result of the testing sequence was a recommended modification in the farming system which could be widely diffused by the extension system in the Experimental Zone and beyond. The Experimental Unit program is now being phased out in Senegal because it is relatively costly and it has not been able to come up with recommended changes in farming systems which have been used by the Extension Service and widely accepted by farmers. Nevertheless, the Experimental Unit program has been a valuable experiment which can be tapped as ISRA reorganizes and decentralizes its national research system. Also, see Boutillier et al. (1962) for multi-disciplinary research effort in Senegal.

Although not strictly considered FSR, research institutes in several other African countries have used "multi-local" trials to test techniques and varieties which appear promising in experiment station trials. Multi-local trials, which correspond to a pre-extension phase of testing a technology, have been valuable in identifying the potential of recommended varieties and techniques in particular agro-ecological zones. Moving technologies from multi-local trials under researcher supervision to demonstration on farmers' fields and adoption by small farmers, however, has continued to be a major problem.

[1/] The top-down approach--research station to the best farmers in the Experimental Unit--has been recently questioned by many FSR researchers. In current FSR research, the bottom-up/top-down approaches are both used. See Byerlee, Collinson et al. (1980).

While FSR represents a major step toward more relevant research, it is yet to be seen whether the approach can be effectively operationalized and whether it will be cost-effective. First, the concept of a multi-disciplinary team for FSR has in practice generally turned out to be a two-discipline team--an economist and an agronomist. The role of the soil scientist in FSR work in Uganda in the 1950s should be heeded. Also, anthropologists can play a major role in identifying the "indigenous knowledge" underlying current practices and constraints on recommended practices (Swanson, 1980). Second, much FSR to date in fact has been cropping systems research. A crucial step is to get research underway on livestock systems and to examine the interrelationships between cropping and livestock systems, marketing and off-farm employment (McDowell and Hildebrand, 1980). Third, FSR may overemphasize short-run, marginal improvements in farming systems based on farmers' perceptions of immediate constraints and underemphasize the importance of strong commodity research programs and the need for strong experiment station research programs.

Farming systems research is not new[1/] and it is not a panacea; it must be tested and refined. It must be supplemented with a vigorous commodity research program and must have strong links with livestock research programs in national and international research centers. In the final analysis, FSR also must be perceived by African researchers to be in their professional self-interest in terms of status, salaries, and promotion. Some preliminary results of FSR are now available as follows: East Africa, Collinson (1982); Tanzania, CIMMYT (1977b); Kenya, CIMMYT (1977a); Zambia, CIMMYT (1978); Nigeria, Norman (1980); Menz (1980); Niger, Raynaut (1980); de Miranda and Billaz (1980); and Upper Volta, Swanson (1980). Collinson (1982) discusses some of the difficulties in getting FSR accepted by agricultural research systems in Eastern and Southern Africa. For an excellent manual on FSR methodology--which is available in English, French, and Spanish--see Byerlee, Collinson et al. (1980). For a recent state-of-the-art paper on FSR, see Whyte (1981).

[1/] Although many advocates of FSR claim that it is a new approach to research, a careful review of history reveals that many of the features of FSR have been incorporated into agricultural research programs in the United States for decades. But FSR is a new approach to research in many Third World countries which traditionally have focused on research on a commodity-by-commodity basis and have carried out most experiments on research stations.

VI. LIVESTOCK

Until recently, social science research on livestock was dominated by anthropologists.[1/] Only in the past few years have economists taken a serious interest in livestock. Moreover, technical scientists have historically concentrated on cattle but in the past few years they have broadened their agenda to include small ruminants--sheep and goats. On the basis of our review of studies on livestock, it is obvious that anthropologists have been preoccupied with pastoralism (nomadic and semi-nomadic herding) and defending the pastoralists (herders). But the structure of livestock production is changing in Africa.[2/] Klaus Meyn, a German livestock specialist with substantial experience in West Africa, reports that the majority of the Fulani in West Africa are sedentarized or in the process of becoming sedentarized and that they are cultivating subsistence crops at their permanent homesteads in Senegal, Mali, Upper Volta, Nigeria, Cameroon, and Central African Republic as do the Arabs in Chad.[3/] The implication of this structural change is the need to focus research in the 1980s on semi-nomadic herding, mixed farming, and small ruminants.

Behavior of Herders: Empirical Evidence

One of the major arguments in the literature over the past 50 years is whether herders in Africa are economically rational in the western sense of being profit maximizers. The debate on herders' motives has been narrowly conceived in terms of which objective herders strive to meet--wealth/prestige or profit. The hypothesis that a primary motive for accumulating large herds is to gain prestige and serve as a store of wealth is important to policy makers because this motive can work against livestock improvement programs which are striving to increase off-take rates and thereby reduce herd size and overgrazing.

The thesis that herders may not be profit maximizers has its origins in Herskovitz's (1926) well-known diagnosis of the "cattle complex," the term he used to draw attention to the highly significant social and religious roles of cattle among the East African pastoralists and the role that large cattle herds may play in serving as a store of wealth and prestige in these societies. But there have been few rigorous tests of the wealth hypothesis. Numerous anthropologists in the 1960s and 1970s reported that herders were

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[1/] The rich body of ethnographic literature on herders and pastoral systems includes: Dupire (1962); Stenning (1959); Gallais (1975); Horowitz (1972); Bernus (1974a, 1974b); Jacobs (1975); Dyson-Hudson (1972); Monod (1975); and Toupet (1977).

[2/] See Part I for an overview of livestock systems.

[3/] Personal communication, June 25, 1980.

insensitive to opportunities to sell cattle when prices were favorable and that herders' negative supply response to price seemed to imply non-profit maximizing behavior. For example, in a study of the Kel Adrar Tuareg pastoral group in northern Mali, an anthropologist, Jeremy Swift (1975), observed that the Kel Adrar did not seem to respond to normal market forces. He observed that the Kel Adrar were nomadic, they had strictly limited cash needs (to pay taxes and buy salt, tea, sugar, and tobacco), and they met their target income when cattle prices increased by selling fewer animals. But Swift later (1977) shifted his position as he stressed the shrewd ability of the Kel Adrar to cope with the Sahelian drought by herd diversification, herd movement, storing feed, and sharing animals.

The study of herder behavior has recently been enriched by research on the relationship between the demography of herd size and the survival of pastoral families under harsh ecological conditions. L. H. Brown (1971), former agricultural officer in Kenya, showed that pastoral families who lived off milk, meat, and grain (obtained by trading milk for grain) required much larger herds to survive during periods of drought than anthropologists had previously believed necessary.[1/] Later Brown (1977) developed a simulation model of the factors influencing herd size for an average pastoral family of eight people in Kenya.[2/] The results of Brown's simulation model show that a family of eight must maintain a herd size of 30-35 adult cattle to ensure family survival in a semi-arid area. Brown's findings show that objectives such as prestige, wealth, or income are likely to be secondary to the survival objective.

An excellent book by two Swedish anthropologists, Dahl and Hjort (1976), entitled Having Herds: Pastoral Growth and Household Economy, adds further support for Brown's stress on the importance of large herds for survival purposes. Dahl and Hjort contend that low off-take rates observed in many countries are not a function of cultural factors.

[1/] Brown reports that pastoralists in Kenya such as the Masai, Samburu, Boran, and Somali live largely on milk with meat eaten mainly in the dry season when milk yields fall and livestock mortality increases. Sometimes blood is also consumed.

[2/] Brown made the following assumptions: herding families consume 75 percent milk and 25 percent meat; calving rate of 70 percent; 14 cows are needed in milk during the year; the number of young stock reared is limited to that required for replacement; and that one-half of the family members are children below 14 years of age. The assumed family of eight (6.5 adult equivalents) requires about 15,000 calories per family.

R. E. McDowell notes that Brown's model has a calving rate of 70 percent which is too high, especially for a pastoral herding situation (Personal communication, June 5, 1980). Stephan Sanford adds "What is unrealistic is not the figure of 70 percent but any single figure. Both on ranches and in pastoral herding situations there are very wide fluctuations between years according to weather, disease, etc. (Personal communication, March 17, 1981).

The World Bank uses a figure of 40-60 percent calving rate for pastoral herders in West Africa.

Rather they are due to technical and economic reasons such as disease, death, and low productivity of the rangeland. From their research in northern Kenya, the authors simulate alternative herd sizes required for the survival of pastoral families under conditions of adversity. They conclude that it is rational for a herder to accumulate a large herd to produce milk for his family as well as to provide an insurance fund and portable bank.

A major weakness of the Dahl/Hjort model is that it does not permit exchange to take place except to allow enough grain to be purchased to meet the minimum physiological requirements of the herding family. Although Dahl and Hjort admit that revisions in their model would be necessary if it were possible to convert some of the produce of the herd into agricultural goods by trade or barter (Dahl and Hjort, 1976, p. 178), they do not stress the fact that almost all of the pastoral groups in Africa are actively engaged in trading milk and cattle for grain except in sparsely populated areas where there are limited market opportunities. For example, Harold K. Schneider (1979) cites numerous studies (e.g., Bates and Lee's, 1977) which show that pastoralists throughout Africa purchase grain--primarily millet--and other products. The Brown and Dahl/Hjort models are abstract and insightful but their predictive value is likely to be very low.

There has been little rigorous research in Africa by economists on the motives for keeping cattle. This is understandable because of the paucity of data on herd numbers, prices, etc. Also, the few economists who have studied livestock have been slow to draw on research findings from Europe, Latin America, and North America which point up the pitfalls in generating short- and long-run supply response coefficients for a sub-sector which is fraught with cyclical patterns of building up inventories--a process that can take years and one that can affect the validity of short-run supply response coefficients. This topic has been explored for many years by economists outside of Africa.

Reutlinger's (1966) study of the beef industry in the United States pointed out that the cow and calf components of beef supply enabled the producer to slaughter for consumption or retain calves to build up inventories. Thus it was perfectly feasible to generate negative short-run supply elasticities among profit-maximizing beef producers in periods when inventories were being built up. Tryfos (1974) reported similar results in his study in Canada. Jarvis (1974) showed that cattle can be used as capital goods or consumption goods in his study of the Argentine cattle industry. Jarvis developed a number of micro-economic models in which producers acted as portfolio managers and held cattle as long as their capital value in production exceeded their slaughter value. His model showed that a negative short-run supply response was consistent with a positive long-run supply response when producers were withholding cattle to build up herds.

Turning to studies of supply response in Africa, Khalifa and Simpson (1972) report a positive supply response to changes in prices for one market in the Sudan but Low (1980) questions the reliability of the data and the validity of the findings of Khalifa and Simpson. In a recent study in Swaziland, Doran, Low, and Kemp (1979) argue that herders keep cattle as a store of wealth (status and prestige) rather than profit maximization and that they are little motivated by market incentives. The authors point out that the quality of data in Swaziland is exceptionally good[1/] for testing the income versus the wealth hypothesis because data on herd size and slaughterings are recorded for 24 years (1950-76) as part of the closely supervised cattle trade with the Republic of South Africa. The authors test the wealth versus income hypothesis by regressing the off-take rate against rainfall and real cattle prices. The regression results revealed an inverse relationship between cattle sales and cattle prices and rainfall and led the authors to accept the wealth/status hypothesis as a motive for keeping cattle. The authors concluded that the government's strategy of reducing overgrazing by improving breeding and pastures will not work even if these interventions would improve the quality of cattle and bring higher prices in South African markets.

In a recent critique, Jarvis (1980) raised serious questions about the Doran, Low, and Kemp findings by pointing out that on theoretical grounds a store of wealth hypothesis could be explained either in terms of a negative short-term price response or the communal grazing system. Jarvis notes that the communal grazing system by itself is capable of explaining the overgrazing, advanced age slaughter, and the other herd characteristics cited by Doran, Low, and Kemp as evidence for the store of wealth motive. Moreover, Jarvis shows that Swaziland government programs which offer incentives to increase beef production will have the desired effect whether or not the store of wealth effects hold. In their reply, Low, Kemp, and Doran (1980) agreed that communal grazing could also explain the wealth hypothesis and that the advanced age of cattle and constant herd composition do not provide convincing evidence for the store of wealth hypothesis.

Turning to West Africa, Delgado (1979a) investigated the behavior of Fulani herders and Mossi sedentary farmers in Upper Volta. Delgado rejected the wealth (status) hypothesis and surprisingly shows that the Fulani are more integrated into the market economy than the crop farmers. He found that the Fulani herders have significantly entered the market economy over time and now sell three-fourths of the value of their annual production of livestock and livestock by-products as compared with the sedentary Mossi farmers who sell one-sixth of the value of their crops (mainly millet and sorghum).

[1/] But Swaziland is an atypical country in that many rural males earn substantial incomes from seasonal employment in South Africa. Thus the behavior of rural households with livestock may be different from full-time pastoralists in West Africa.

In summary, research on the behavior of livestock herders in Africa is about at the same point where research was on the economics of crop production some 20 years ago--many assertions and a sparse supply of facts.[1/] L. H. Brown and Dahl and Hjort's findings that pastoralists need to maintain large herds for the survival of the pastoral family under harsh ecological conditions are important contributions of the 1970s. Communal grazing is now recognized as an important contribution to overgrazing. There is now agreement that cattle perform a number of social, ritual, and economic functions and that the relative ranking of these functions will vary widely according to ethnic group, country, ecological conditions, etc. What was earlier alledged to be ultra conservative behavior of herders is now viewed as prudence. Ayuko summarizes Kenya's experience with livestock projects over the past 40 years as follows:

> "One of the most significant lessons arising from the experience of these projects is that the alledged ultra conservatism of pastoralists towards proposed technological interventions is more appropriately viewed as prudence. Pastoralists welcome modern technology when they perceive its beneficial relationship to the basis of their economy and culture and they will accept change at their own pace, if it is introduced under their control, that is initiated and directed by senior elders who are aware of the advantages the proposed change will bring, and provided it does not undermine their established culture" (1980, pp. 22-23).

Livestock Production: Major Issues for Researchers

African governments and donors are channeling millions of dollars each year into livestock projects throughout Africa in the absence of a sound knowledge base.[2/] For example, the CILSS/Club du Sahel's livestock strategy (IEMVT, 1980) for the development of livestock in the eight Sahelian countries is little more than a shopping list of projects for donors.[3/] The project-by-project approach to livestock development is doomed to failure in the absence of a coherent strategy which by necessity must be rooted in a strategy for agricultural development, including a basic knowledge of the interaction

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[1/] The need to learn from past mistakes was a common theme at AID's workshop on pastoralism (AID, 1980).

[2/] But a few economists are now starting to pursue systematic and comparative research on livestock. A major study of livestock production and marketing in West Africa by the Center for Research on Economic Development (CRED) at the University of Michigan is available in a synthesis by Shapiro (1979) and reports by individual team members: Delgado (1979a); Eddy (1979); Herman (1979); and Staatz (1979). ILCA's comparative research program is growing in stature and ILCA's technical publications supplement the ethnographic foundation laid by anthropologists over many decades.

[3/] The CILSS/Club du Sahel livestock strategy for the Sahel was prepared by the Institut d'Elevage et de Medecine Veterinaire des pays Tropicaux (IEMVT) in Maisons-Alfort (France) and the CILSS/Club du Sahel Livestock Team (see IEMVT, 1980).

between the cropping and livestock subsectors. The following discussion reviews research on key problem areas and points to needed research to expand the knowledge base in the 1980s. A major point which emerges from this section is the need for a substantial increase in research on technical problems.

Improving the Data Base

The starting point for a discussion of livestock interventions is to realize that government censuses of livestock are among the most unreliable of official data in Africa. Planners need data on national herd size, off-take rates, and mortality rates. The difficulties of generating reliable production data are understandable in light of the large percentage of cattle in semi-nomadic and to a lesser degree in nomadic systems. An example from Tanzania points up the need to question published data about national herd size and off-take rates. MacKenzie (1976) reports that the Government of Tanzania decided to emphasize marketing rather than production interventions in preparing its 1973 application for a $27 million loan from the World Bank because it assumed that the national herd size was adequate. But subsequently, the unofficial results of the 1971/72 National Livestock Census revealed a national herd size of only 9.4 million. The difficulty of generating reliable cattle counts in Kenya through survey research led Aldington and Wilson (1968) to use hides as a proxy for off-take. But Schneider (1979) observes that some herders like the Pokot in Kenya "destroy the hide in the act of sacrifice." Ferguson (1967) points out some problems in using hide figures to estimate herd size in his beef subsector study in Nigeria. Other techniques for generating information on herd size include data obtained from rinderpest vaccination campaigns, slaughter figures, and aerial counts. Some authorities argue that data from cattle vaccination campaigns provide estimates on the size of the national cattle herd which may be as reliable as official data on the acreage and yields of subsistence crops. The head tax on cattle is another reason why it is difficult to carry out survey research to determine herd sizes.[1/]

Another data gap is returns to labor in various livestock activities. While there is now universal agreement on labor constraints in performing certain cropping activities in Africa, there is a large void on returns to labor in livestock. For example, because of overgrazing associated with deep bore holes with motor-driven pumps, a number of animal specialists are recommending a shift to shallow, lined wells from which water can be drawn with a bucket, thereby reducing the number of cattle which can be maintained. But in the discussions of shallow wells, labor is usually assumed to be free--a questionable

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[1/] Most countries impose a head tax on cattle and sometimes on sheep and goats. Livestock owners, of course, try to evade these taxes and are suspicious of government officials and researchers trying to gain knowledge about their herds. This is one of the reasons why Nigeria recently abolished the cattle tax. For information on cattle taxes, see Van Raay (1975) and Stenning (1959).

assumption as we pointed out in Part IV.

Herders or Ranches?

A perennial debate since the colonial period is whether governments and donors should concentrate on assisting herders who are subsistence-oriented or on promoting ranches which produce exclusively for the market.[1/] Those who support the herder strategy stress the advantages of a migratory pastoral system in response to seasonal changes in rainfall and drought, the accumulated expertise of herders, and the general failure of ranching schemes.

There is a long history of anti-herder sentiments. For example, Allan (1965) contended that "Nomadic pastoralism is inherently self-destructive." Two authorities on range management in East Africa, Pratt and Gwynne (1977), assert: "In most cases . . . the people (pastoralists) are tied to a way of life that limits their own development and that leads to overstocking of the land." A leading Nigerian animal scientist, Professor V. A. Oyenuga, threw his prestige behind ranches by concluding that "the required production level can no longer be met by adhering solely to the traditional practice . . . . It calls for well-managed, heavily capitalized ranch systems supplied with feedlots on an intensive management basis" (Oyenuga, 1973, p. 395).

Large-scale government ranches were tried in numerous countries over the 1960-75 period with the support of the World Bank and several bi-lateral donors. But commercial and government ranches have performed poorly in most countries. Ranching has generally failed because of high investment costs and low returns. Von Kaufmann (1976) reports that ranches in Kenya are usually large; they receive massive loan support and government subsidies and they benefit the few. Odell and Odell (1980) document the difficulties the Government of Botswana experienced in setting up commercial ranches in the early 1970s.

The failure of numerous commercial and government ranches in the past two decades, supplemented with increasing population pressure and concerns for equity, have forced many governments to de-emphasize commercial ranches and move toward group ranches,[2/] grazing blocks[3/] (associations), and assistance to small herders. But group

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[1/] For a study of an attempt by a Liverpool subsidiary--African Ranches--to establish a 16,000 acre ranch in northern Nigeria in 1914, see Dunbar (1970). The ranch was operated from 1914 until it failed in 1923 and was turned over to the colonial government.

[2/] A group ranch is operated by a group of people who jointly have freehold title or the use rights of land and agree to continue to own cattle individually and herd animals collectively at agreed upon stocking levels.

[3/] A grazing block or association is a delimited pastoral area where some infrastructure improvements are made--especially improved water sources. A system of rotational grazing is overseen by a government grazing manager.

ranches and grazing blocks are extraordinarily complex; they require systematic pre-development analysis ranging from surveys of land and water use and socio-cultural aspects of traditional grazing systems to the enactment of legislation to allow adjudication of group landholding rights (Ayuko, 1980a). For example, Odell and Odell note that the failure of commercial ranches in Botswana was followed by a failure of the government to establish 40 group ranches in the mid-1970s because of "enormous logistical, managerial, technical, ecological, social, economic, and political problems" (1980). The Odells noted, however, that these failures were invaluable in stimulating land use planning and in forcing central planners to realize that communities themselves must play a more active role in land use planning, including sanctions to prevent overgrazing. Doherty's (1979) preliminary analysis of group ranching in Narok District, Kenya, suggests that efforts to promote group ranching in Kenya appear to have increased factionalism among the Masai. In summary, the evidence (economic, political, and social) is overwhelmingly against ranches in Africa. Research suggests that African governments should help herders improve the productivity of their herds and assist them in experimenting with grazing associations and other systems by which group action can maintain agreed upon stocking levels.

Animal Breeding

The technical coefficients for livestock are unfavorable in most African countries (ILCA, 1978, 1979a,b,c). Depending on breed and level of nutrition, the first birth ranges from two to five years. Calving rates, defined as the percentage of cows giving birth during one year out of the total number of cows and grown heifers, are low with rates ranging from 40 to 60 percent among pastoralists. Calf mortality rates commonly are 20 to 30 percent and often exceed 50 percent during disease outbreaks or periods of low rainfall. The annual off-take rate (yield) of herds is generally 10 percent or less per year.[1/] Most herds are composed of indigenous Zebu and Sanga cattle, which do not have the genetic potential of cattle in temperate zones either in terms of weight gains or milk production. But the Zebu and Sanga are well adapted to environmental conditions and the low levels of management found in many parts of Africa. Comparative studies of breeding and feeding problems are starting to clarify the nature of these technical

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[1/] It is difficult to compare off-take rates in different countries because different assumptions are often used in computing the coefficients. The rate can vary widely depending upon at what point you aggregate data. For example, in the computation of the off-take rate, do you include the number of animals consumed by herding families and the number sold or only the animals sold? Do you include animal deaths? Finally, the choice of the base year is difficult because of the lack of reliable livestock censuses. When one considers these problems, one understands why off-take rates should be taken with a "grain of salt." The off-take rate for livestock in the U.S. is around 20 to 25 percent per year as compared with 12 to 16 percent per year on commercial ranches in Kenya and 8 to 12 percent for pastoral herds throughout Africa. But an off-take rate by itself does not tell us very much.

constraints. A recent study by ILCA and the Institute of Rural Economy in Mali (ILCA, 1978) reports that the body weight of Maure and Peul cattle increased by only 7.5 percent per year over the 1966 to 1975 period, the mortality rate of all calves from birth to age three was 26 percent, and that 56 percent of all females born were required as herd replacements.[1/]

Cattle Feeding and Animal Nutrition

The lack of a reliable feed supply is a major technical constraint on animal production. Numerous studies in West Africa have shown that regardless of the stocking rate and the type of forage it is impossible to prevent cattle, sheep, or goats from losing weight during the dry season without supplemental feeding. A study of supplemental feeding of small herds in Senegal by Calvet, Friot, and Gueye (1976) revealed that there was a "substantial" reduction of dry season weight loss achieved by the feeding of 300 g of groundnut cake per animal unit per day but the authors did not investigate the economics of feeding groundnut cake.[2/]

A major issue in increasing feed supplies is pasture improvement. The tender shoots or twigs of shrubs and trees (browse) are increasingly recognized as a source of feed for domestic and wild animals, especially during drought or seasonal periods of nutrition stress (De Leeuw, 1965; Brinckman and De Leeuw, 1979; ILCA, 1980b). The deliberate burning of grazing land has been the subject of a great deal of speculation but research has shown that burning of the mature grass can improve both protein content and nutritive value. Although there are benefits of burning--prepares land for cultivation, destroys mature grass, improves protein and nutritive value of new grass flush, and destroys parasites--there are obvious negative features such as destruction of forests and removal of soil cover which might increase erosion. But the consensus is that when the range or savannah is used primarily for grazing, there is probably no alternative to periodic burning. (See De Leeuw, 1965; Van Raay, 1975; and Bremen and Cisse, 1977.)

H. Ruthenberg (1974) and Doppler (1980) provide some of the first estimates of the economic potential of investments in permanent pastures in semi-humid areas in West Africa. Doppler concludes that the economic incentive for introducing or expanding beef production in a semi-humid zone in Togo is small and risky. He draws on data from two ranches in Togo for his simulation model and concludes that the costs of pasture development are too high for investing in pasture improvement on ranches.

[1/] One should keep in mind that these data include the 1968-74 Sahelian drought period and, as a result, they might be biased downward.

[2/] Unfortunately, most research on supplementary feeding and animal nutrition has been carried out on experiment stations or on enclosed ranches in countries such as Zimbabwe and South Africa.

A number of animal scientists such as R. E. McDowell (1978) stress the strategic role of improving animal nutrition as a prerequisite for increased weight gains and reduced mortality from disease. A simulation model of the livestock economy in northern Nigeria (Manetsch et al., 1971) demonstrated that improvement in animal nutrition was the most significant intervention to increase livestock production. A recent study of herders with White Fulani cattle on the Jos plateau in Nigeria found that disease was not a serious problem in the study herds and that the major factor affecting productivity was poor nutrition, especially in the dry season (Pullan and Grindle, 1980). All herds studied were relatively unproductive as regards fertility, growth rates, off-take, and milk production with the exception of one herd which received a significant amount of dry season supplementation. But again, the economics of supplementation was not investigated. In summary, research on supplemental feeding, animal nutrition, and pasture improvement under herder conditions is in its infancy. One authoritative reviewer--Stephen Sanford--summed it up as follows: "range science applied to Africa is fraudulent because it has never done adequate local homework before pontificating (northern Nigeria is a slight exception to this rule)."[1/]

Cattle Diseases and Parasites

The seven major cattle diseases and parasites in Africa in order of importance are as follows: (1) rinderpest, (2) contagious pleuropneumonia, (3) clostridial diseases, (4) internal parasites, (5) trypanosomiasis, (6) East Coast fever, and (7) foot and mouth disease.[2/] Trypanosomiasis at present is receiving the most attention by researchers because rinderpest, contagious pleuropneumonia, and clostridial diseases are controlled by vaccination[3/] and because tsetse flies virtually preclude the use of approximately one-third of the African continent, including some of the best watered and fertile land. Trypanosomiasis is one of the major constraints on intensified livestock production and rainfed farming in sub-Saharan Africa. The flies are the vectors which transmit several species of trypanosomes, causing human sleeping sickness and trypanosomiasis in livestock (J. Ford, 1971; ILCA, 1979c; FAO, 1981a).

Present tsetse control measures include clearing of vegetation which harbors flies, spraying of insecticides by helicopter, ground spraying, breeding and release of sterile

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[1/] Personal communication, March 17, 1981.

[2/] There is a wide variation in the ranking of the types of diseases in Asia, Latin America, and Africa. In Latin America, the number one cattle disease is foot and mouth disease, while in Africa it is number seven on the list.

[3/] For a cost-benefit analysis of vaccination programs in Africa, see ILCA (1979d) and Felton and Ellis (1978). For a study of the economics of tick control in Tanzania, see Grindle (1980).

male flies, and the use of traps. Specialists believe that tsetse flies can be economically controlled only in combination with sedentary agriculture/livestock systems because it does not pay to clear land only for livestock grazing.[1/] Moreover, the cleared land will be overtaken by tsetse unless there is a minimum human population density which farms it and keeps it cleared. For a valuable analysis of Uganda's attempt to control tsetse flies in the 1960s, see Talbot (1972) and Jahnke (1974). A large spraying program in northern Nigeria in the late 1950s has not been able to prevent the resurgence of trypanosomiasis (Putt et al., 1980). A large-scale tsetse eradication program by spraying is underway on the Adamawa Plateau in Cameroon. An ILCA (1979c) study reports that trypanotolerant N'Dama and West African shorthorn cattle are economically attractive in tsetse-infested environments where other breeds can only be maintained under high levels of management based on chemoprophylaxis and therapy. For example, the N'Dama and shorthorns have been successfully introduced into Central African Republic, Gabon, and Congo where tsetse had prevented the introduction of the Zebu or Sanga cattle from surrounding areas.

Range Management and Land Use Planning

Many governments, donor agencies, and scholars argue implicitly or explicitly that overstocking is the basic cause of soil erosion, desertification, and degradation of the range in many African nations.[2/] Interest in the overgrazing and desertification was stimulated by the livestock losses during the 1968-74 Sahelian drought. For 25 years preceding the drought, the livestock population in the Sahel increased significantly because of above average rainfall, expansion of public water facilities, and improved veterinary services (Bernus and Savonnet, 1973; Gallais, 1977). Because of livestock migration across national boundaries during and following the drought, the losses for the Sahelian region are rough estimates. The FAO (1975a) estimates that the total cattle population in the ECOWAS countries declined 23 percent (35.5 million in 1971 to 27.3 million in 1974) over the 1971-74 period. Farmer/herder conflicts were numerous as a result of the abrupt shifts in migration streams during and following the drought.[3/] For

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[1/] Some 1981 estimates of tsetse eradication by insecticides are $20/ha for eradication and $5/ha/year for maintenance. These costs cannot be recovered by livestock profits alone but they could be recovered by mixed farming or agricultural production.

[2/] This is a worldwide problem. For a discussion of mistakes in land use planning for pastoral zones in Australia, see M. D. Young (1979).

[3/] Farmer/herder conflicts are particularly serious in West Africa. See Van Raay's (1975) analysis in northern Nigeria and Diarra's (1975) and Horowitz' (1972, 1977) studies of Fulani herders and Hausa farmers in northern Niger. Population pressure in the sorghum and millet belt in southern Niger is forcing Hausa farmers to move their cultivation northward into lower rainfall areas traditionally used by herders, resulting in a severe threat to herders.

example, many herdsmen from Upper Volta and Mali drove their herds south in search of water and better grazing land.

Research is showing that desertification is a complex and long-run process. In the early 1970s, a few alarmists claimed that desert encroachment in the Sahel was advancing at the rate of up to 100 miles per year. But Bernus and Savonnet (1973) have pointed out that the boundary between the Sahel and the desert to the north was elastic and although three major droughts over the past 100 years had induced desert encroachment, there was a "retreat" of the desert after normal rainfall resumed and the range recovered. Lovejoy and Baier's (1975) analysis of this drought/recovery cycle reveals that migration from the drought-stricken areas was carried out in an organized fashion. It is now accepted that "only over periods longer than a decade can desertification be clearly distinguished from the less lasting effect of drought" (Warren and Maizels, 1977).[1/] But even though desertification may not be occurring in the technical sense, the issue of environmental deterioration is a serious problem in many parts of Africa.

The argument that controlled grazing is a prerequisite for improving pasture productivity is echoed throughout Africa by policy makers and donors. A popular view is that overgrazing in the Sahel is a classic case of "A Tragedy of the Commons." Controlled grazing schemes have been more aggressively pursued in East Africa than in West Africa. The best-known schemes have involved the Kamba in Kenya and the Masai in Tanzania and Kenya (Talbot, 1972). For a historical perspective on Masai pastoralism, see Jacobs (1975, 1978). Over the 1946-61 period, the British colonial government introduced large-scale grazing schemes and range demonstrations among the Masai in Kenya and Tanzania. In fact, much of the cost of the grazing schemes was covered by the Masai through self-tax levies. Nevertheless, Jacobs (1975) notes that the schemes were considered a failure for the following reasons:

> In their failure the grazing schemes clearly demonstrate the futility of water development and management measures without control of the livestock population. The danger of water development and range improvement projects in general without adequate management provisions cannot be too strongly stressed for almost invariably the result is the deterioration or destruction of the range resource involved.

In West Africa, there were colonial systems of controlled grazing supervised by local chiefs (e.g., in the Niger Delta in Mali) which broke down with national independence when national governments took over the rights to control land use.

The three-way competition for land--livestock, game and forest reserves, and crops--has led to recent decisions to establish national land use planning capabilities and legislation in Tanzania and Botswana (e.g., Tanzania's 1964 Land Use Planning Act and Botswana's 1975 Tribal Lands Grazing Policy). (See Botswana, 1975; and Hinchey, 1978.)

[1/] See Paylore (1976), Paylore and Mabbutt (1980), and Hinchey (1978) for bibliographies on drought and desertification.

The purpose of the legislation is to encourage socially optimum use of grazing land and natural resources. Research is urgently needed on the multi-faceted dimensions of land use. Hitchcock (1978), an anthropologist, has provided a wealth of information on indigenous systems of keeping cattle in Botswana. This type of ethnographic information will be invaluable in developing socially optimum methods of livestock management in the 1980s and 1990s.

Small-Scale Fattening Schemes

Small-scale fattening schemes may be a desirable alternative to continued open grazing or ranching. There are two basic types of fattening schemes. The first is to remove the range steers from the range for a 60-90 day fattening period. The second and more common fattening scheme is part of a mixed farming system whereby a crop farmer becomes a mixed farmer by adding livestock for oxen cultivation and then fattening one or two of the cull oxen with supplementary feeding during the dry season. Available research on mixed farming is sparse but preliminary findings suggest that a mixed farming strategy is profitable only if it can be linked to cash crops such as groundnuts and cotton. In the Tenkodogo region of Upper Volta, Delgado (1979a,b) found that small farmers who added a livestock enterprise and became mixed farmers (a) found it difficult to graze the animals in their unfenced fields, (b) faced a seasonal labor conflict because major labor requirements for managing livestock coincided with the harvesting of millet and sorghum in November, and (c) lacked dry season fodder for their animals. Delgado concluded that government policies should be directed toward improving the present "entrusting" system whereby nomadic (Fulani) herders care for animals owned by sedentary (Mossi) farmers rather than encouraging farmers to add a livestock enterprise and become mixed farmers.[1/]

Mali has experimented with two types of small-scale fattening programs--one unsuccessful and one successful. The unsuccessful scheme was a cull oxen model which was started in the mid-1970s under the assumption that a massive expansion in animal traction would provide cull oxen for fattening by small farmers. For various reasons, this plan was dropped. A successful model of fattening of thin range steers has been developed in Mali since 1975 as part of a USAID Livestock I project. This program is a

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[1/] There were two major problems in Delgado's linear programming study. First, because there were only a few farmers in his sample using animal traction, Delgado had to rely on questionable animal traction coefficients from IRAT experiment station results rather than from actual farm conditions. Second, he assumes that adult rather than child labor of the sedentary farmers is needed to care for animals when millet and sorghum are being harvested. However, Barrett et al. (1982) report that children of a fairly young age manage herds of goats and cattle in Upper Volta. See also Stenning (1959) and Dyson-Hudson (1972) for discussions of child labor.

dry season fattening scheme (embouche paysanne) in which small farmers receive supplementary feed, extension, veterinary care, and credit for 90-day feeding programs for approximately two head of cattle per farm (Delgado, 1980).

Eddy's (1979) LP study of mixed farming among the bush Tuareg in Niger illustrates how mixed farmers in harsh terrain have developed an intricate, mixed farming system of cattle, goats, and grain production to cope with drought and fluctuations in grain prices. In spite of government appeals for the Tuareg to produce more cattle and less grain in the pastoral zone, they still produce enough grain for their family consumption because of their experience in being forced to purchase grain for family survival at greatly escalated prices during the 1968-74 drought. In short, mixed farming, like intercropping, is an effective way to spread risk. A fattening scheme in Niger is discussed by Wardle (1979).

Small Ruminants

Whereas small ruminants (sheep and goats) in Australia, New Zealand, and the Middle East have a three-fold objective--meat, milk, and wool--small ruminants are used almost exclusively for meat and milk production in Africa. In Muslim areas, sheep production is mainly aimed at producing rams which are consumed or sold for slaughter during religious festivals, and other ceremonies, etc. Since the research base on small ruminants is modest and because small ruminants are produced almost exclusively by small herders and farmers in Africa, more attention should be given to research on small ruminants (see McDowell and Bove, 1977; McDowell and Hildebrand, 1980). ILCA has a comparative research program underway on small ruminants (1979a). See also Mathewman (1979).

Research Direction

We are convinced that there is a need for a quantum increase in research on livestock by technical scientists and by economists in the 1980s in order to catch up with the impressive knowledge base that has been put into place by anthropologists over the past 40 years. But research, in our judgment, should move from narrow disciplinary interest--such as supply response studies--to problem-solving research under field conditions. For example, there are few rigorous studies of the technical, economic, and social issues involved in mixed farming, including the economics of supplementary feeding during the dry season. Another example is the need for research on the land tenure issues involved in the transition from nomadic to semi-nomadic and sedentary production systems. For an excellent state of the art paper on the interaction between cropping and livestock systems in the semi-arid tropics, see McCowan, Haaland, and DeHaan (1979). It goes without saying that multi-disciplinary research is essential in addressing these problems.

Livestock References

Bibliographies and Literature Reviews: Ferguson and Sleeper (1976); Dahl and Hjort (1979); Ergas (1979).

Worldwide: McDowell (1972); McCown, Haaland, and De Haan (1979).

Africa, General: Allan (1965); de Wilde et al. (1967); Bates and Lees (1977); L. H. Brown (1971, 1977); Dahl and Hjort (1976, 1979); J. Ford (1971); Goe and McDowell (1980); Darling and Farvar (1972); AID (1980); Konczacki (1978); McDowell (1972); McDowell and Bove (1977); McDowell and Hildebrand (1980); Monod (1975); Galaty et al. (1981); Salzman (1980); Warren and Maizels (1977); FAO (1981a); ILCA (1979d, 1980a,b,c); Felton and Ellis (1978).

West Africa: Bernus and Savonnet (1973); Ariza-Nino and C. Steedman (1979, 1980); Ferguson (1976); Sargent et al. (1981); Ruthenberg (1974); ILCA (1979a,b,c); Kafando (1972); Shapiro (1979); Doppler (1980).

Sahelian West Africa: SEDES (1974); Breman and Cisse (1977); FAO (1977); Gallais (1977); Horowitz (1977); IEMVT (1980); Riesman (1978); Swift (1977).

East Africa: Jacobs (1975); Pratt and Gwynne (1977); Schneider (1979); Talbot (1972); Helland (1980).

Angola: De Carvalho (1974).

Botswana: Botswana (1975); Hitchcock (1978); Hjort and Ostberg (1978); Odell and Odell (1980); Sanford (1977); Fortmann and Roe (1981); S. F. Eicher (1981).

Cameroun: J. Holtzman, J. Staatz, and M. Weber (1980); Zalla et al. (1981).

Ivory Coast: Staatz (1979).

Kenya: Aldington and Wilson (1968); D. Campbell (1979); R. K. Davis (1971); Doherty (1979); Hopcroft and Ruigu (1976); Ruigu (1978); P. Spencer (1973); Von Kaufmann (1976); Dahl (1979).

Mali: Delgado (1980); Gallais (1975); ILCA (1978).

Mauritania: Grayzel (1977); Swift (1975); Toupet (1977); Vermeer (1981).

Niger: Horowitz (1972); Bernus (1974a); Diarra (1975); Dupire (1962); Eddy (1979).

Nigeria: Stenning (1959); A. Cohen (1965); De Leeuw (1965); Ferguson (1967); Fricke (1979); Putt et al. (1980); Manetsch et al. (1971); Awogbade (1979); Van Raay (1975); Dunbar (1970); Brinckman and De Leeuw (1979).

Swaziland: Low and Kemp (1977); Doran, Low, and Kemp (1979); Low, Kemp, and Doran (1980); Fowler (1981).

Tanzania: MacKenzie (1976); Jacobs (1978); Grindle (1980); Zalla (1981).

Togo: Doppler (1980).

Uganda: Jahnke (1974); Eilam (1973).

Upper Volta: Barrett et al. (1982); Delgado (1979a, 1979b); Gooch (1979); Hermann (1979); Riesman (1977); Tyc (1975).

Pastoral Migration: Stenning (1959); I. M. Lewis (1975); Dahl and Hjort (1979); Hjort (1979).

Economic Theory and Behavior of Pastoralists: Herskovitz (1926); Reutlinger (1966); Khalifa and Simpson (1972); Jarvis (1974); Tryfos (1974); Doran, Low, and Kemp (1979); Low, Kemp, and Doran (1980); Schneider (1979); Jarvis (1980); Livingstone (1977b); Low (1980); Crotty (1980).

VII. TRADE, MARKETING, CREDIT, AND CONSUMPTION

In this part, we turn from agricultural and livestock production to empirical research on food and agricultural distribution systems, including international trade, local trade and marketing, transportation, processing, and storage; credit and rural financial markets; cooperatives; and consumption and nutrition.

International Agricultural Trade

Trade policies are particularly important in Africa since most African economies are open with foreign trade often accounting for around a quarter of GNP (World Bank, 1981b).[1/] Research on international agricultural trade policies has focused on: (1) export linkages; (2) the role of intra-African trade; (3) regional integration; (4) special trade agreements; and (5) food aid.

Export Linkages

The central issue in research on policies to promote export commodities such as coffee, cocoa, cotton, and tea has been the long-run impact of these policies on the domestic economy. Drawing on arguments first presented by Prebish and ECLA researchers, many researchers and policy makers have criticized policies continuing the reliance on trading patterns established during colonial rule and primary commodities which face low-income elasticities of demand (I. G. Stewart and Ord, 1965). For example, Clower et al. (1966) argue that Liberia experienced "growth without development" in the 1960s because of the weak linkages between production for export and the domestic economy. Several case studies in Pearson and Cownie (1974) project the net social gains, domestic resource costs, and linkage effects of export-oriented policies. Case studies include cotton in Uganda (V. Jamal), cocoa and coffee in Ivory Coast (J. D. Stryker), cocoa in Ghana (S. L. Gorden), and coffee in Ethiopia (T. Haile-Miriam); the results show that weak forward and backward linkages have limited the potential impact of export-led growth. But the studies also show that exports can contribute to national income via final demand linkages when most of the revenue goes to smallholder producers such as tea production in Kenya. Recent studies of the effects of export promotion in agricultural trade include Jabara and Thompson's (1980) analysis of Senegal's dependence on groundnuts; Franco's (1981) appraisal of cocoa prices in Ghana; Priovolos' (1981) study of coffee trade in the Ivory Coast; and Stein's (1979) analysis of trade in East Africa. See also the studies using a dependency framework cited in Part II.

[1/] The World Bank report (1981b) contends that the deteriorating trade position of most African countries in the 1970s reflects a failure of trade and exchange rate policies to provide incentives for agricultural production and exports.

Intra-African Trade

Trade within Africa has played a central role in studies of African history (A. G. Hopkins, 1973). Although many African leaders have called for greater African unity and a concomitant increase in intra-African trade (Mboya, 1967) the amount of intra-African trade is still modest today. Studies supporting the case for increased intra-African trade include Vinay (1968), Chileshe (1977), and Akinwumi and Adegeye (1977). Vinay acknowledges the large amount of clandestine trade among African countries (see also Collins, 1976) but goes on to develop a case for substantially increasing the proportion of international trade which is carried out within Africa. But the question of barriers to increased intra-African trade involves more than the level of import and export duties. There are major institutional barriers to increased trade, including the lack of agreement on common grades for agricultural products such as maize and sorghum, language barriers, and financial and communication networks which link African countries to Europe rather than to each other. Chileshe's work (1977) is a useful source of data on the level of intra-African trade and the potential role of trade among African countries. Acknowledging several problems in trying to quantify intra-African trade, Chileshe nevertheless argues that intra-African trade is substantially higher than it has generally been thought to be. Chileshe points out that although it is increasingly being recognized by African policy makers that more intra-African trade would be mutually beneficial, there is agreement that existing international marketing agreements (e.g., the GATT agreement) are major constraints on the expansion of intra-African trade.

Regional Integration

Organizations to promote intra-African trade have had a chequered history dating from the Federation of Nyasaland (Malawi and Rhodesia) to the East African Community and more recently to the West African Community (ECOWAS). The most recent failure is the East African Community (EAC)--comprising Kenya, Tanzania, and Uganda--which was established in 1967 and "unofficially" dissolved in 1978. The EAC faced many of the common problems associated with integration schemes in other continents, including disagreements over how to distribute gains and wavering political support. Ndegwa (1968) evaluated the long-term importance of import-substitution in the economic development of East Africa. Hazlewood (1979) analyzes the factors leading to breakup of the East African Community; he concluded that Kenya, Uganda, and Tanzania were more closely integrated on an informal basis before independence than in later years and that the formal treaty proved to be divisive. Key problems leading to the demise of the East African Community in 1978 were: (1) dominance of Kenya's position in the industrial field and the inability to agree on the location of new industrial plants to allow Uganda and

Tanzania an opportunity to "catch up";[1/] (2) disagreements over the distribution of gains, particularly through transfer taxes among member countries; (3) continuing balance of payment problems; (4) weak coordination of regional transportation; (5) inadequate investment program by the East African Development Bank; and (6) different development strategies pursued by Kenya and Tanzania. Weber and Hartmann (1977) criticized the EAC for failing to establish common agricultural policies to the detriment of trade in agricultural commodities within the EAC.

Special Trade Agreements

An important avenue open to countries to increase their gain from exports is to enter into special trade agreements such as commodity agreements. But commodity agreements have met with little success, largely because no single African country is a dominant supplier of a particular commodity. For an assessment of commodity agreements, see Gwyer (1973). Etherington (1972) used an oligopolistic framework to assess the potential benefit of Kenya's participation in an International Tea Agreement. He argued that because East African countries are small, they could expand production with little impact on price and they would be in a strong bargaining position with India and Ceylon who need a tea agreement to stabilize export revenues.

An alternative to commodity agreements is broadly defined concessionary trade agreements, such as the 1975 Lome agreement between the EEC and 48 African, Caribbean, and Latin American countries. The Lome convention represents an attempt by the EEC to compensate for the loss of bilateral privileges by developing countries, particularly former colonies, when the European Economic Community was formed. The Lome convention was designed to promote trade cooperation, to stabilize export earnings, and to accelerate financial and technical aid. Under the agreement, up to 94 percent of the agricultural exports of the developing country members were to enter the EEC duty free. While it is too early to assess the long-term impact of the Lome agreement, it has been criticized on the grounds that liberalization is far from complete and that nontariff barriers remain largely intact (S. Harris et al., 1978; Akinwumi and Adegeye, 1977). For a radical critique of the Lome convention, see Galtung (1976).

Food Aid

Until recently, almost all food aid in Africa was for emergency purposes but food aid for development is now becoming firmly entrenched in a number of countries, such as

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[1/] For example, Coulson (1977a) points out the duplication of fertilizer plants in East Africa and the power struggle between Kenya and Tanzania over the location of factories.

the Sudan, Zambia, Ghana, Senegal, Tanzania, and Zaire. The debate about food aid basically turns on the possible disincentive effects of food aid on domestic production and saving. If the food aid is sold on the open market, it may depress prices and, therefore, dampen producer incentives. The availability of food aid is also thought to allow governments to avoid making the necessary investments in research, extension, and credit to expand food production. Although they primarily rely on evidence from sub-Saharan Africa, Maxwell and Singer's (1979) valuable survey of food aid suggests the following criteria for the effective use of food aid: (1) there should be a clear need for food assistance, (2) food aid should substitute for commercial imports, (3) food aid programs should be incorporated into poverty-oriented programs, (4) there should be a guarantee that food aid will be available when promised, and (5) food aid and financial aid should be coordinated.

One of the few attempts to assess the impact of food aid in sub-Saharan Africa is Stevens' (1979) analysis of Botswana, Lesotho, Upper Volta, and Tunisia. The focus is on the effect of food aid as a form of development assistance rather than emergency relief. Based on available evidence, Stevens infers that there is no proof that food aid has had a direct disincentive effect on agricultural production, but he cautions that the limited amount of food aid in the four case studies makes it difficult to ascertain the impact of food aid on the aggregate price level and on the prices of particular commodities. The general conclusion of the Stevens' study is that if food aid is additional to financial aid, it is worthwhile, although care is needed to ensure that its potential disadvantages are minimized.

Local Trade and Food Marketing

Marketing research during the 1950s and 1960s concentrated on marketing boards and on the movement of export crops. Few researchers were concerned with the economics of local trade or food marketing. W. O. Jones (1972) contends that the neglect of food marketing during this period may have been due to the fact that local markets were adequately performing their major task (from the perspective of policy makers) of assuring food supplies to urban markets. But during the 1960s and 1970s, urban centers grew rapidly and the view spread among planners and policy makers that (1) unreliable local markets encourage farmer self-sufficiency which inhibits the provision of stable

food supplies to urban centers,[1] (2) farmers are, for the most part, thought to be price takers subject to the whims of traders who collude to lower producer prices,[2] and (3) government intervention in food marketing was necessary to ensure regular supply of food to cities.

Over the past 15 years, research on local trade and food marketing has been a medium priority research topic. Riley and Weber (1979) reported that over 50 U.S. Ph.D. dissertations were completed on marketing in sub-Saharan Africa during the 1970s. But research coverage has been uneven both geographically and in the range of topics covered. Moreover, there has been considerable variation in research findings in different studies and among different countries. For summaries and assessments of the literature, see W. O. Jones (1972); Whetham (1972); Wilcock (1978); CILSS/Club du Sahel (1977); Lele (1977); Couty (1977); and B. Harriss (1979a,b). For annotated bibliographies, see Arditi (1975); CILSS/Club du Sahel (1977); and Riley and Weber (1979).

Studies by Geographers and Anthropologists

Much of the research on local traders and markets has been carried out by geographers and anthropologists who have described marketing channels, including the origin and timing of markets, the role of ethnic groups in determining market patterns, and the impact of local markets on social relations. For the most part, anthropological case studies which dominated marketing research in the 1950s and 1960s paid little attention to economic issues such as the volume of food trade, price determination, operating margins, or the capacity of markets to handle expanded production (W. O. Jones, 1972). A classic collection of 28 case studies on local marketing is Markets In Africa (1962) edited by Bohannan and Dalton. A shortcoming of the case studies was a failure to examine the linkages between rural periodic markets and regional and national marketing systems.

Research by anthropologists and geographers on the origins of local markets has revealed that the reasons for the development of local markets and the length of time that formal markets have existed vary greatly throughout Africa. For example, Hodder found that traditional markets in Yorubaland, Nigeria have a long history and that their growth was closely associated with long-distance trade (Hodder and Ukwu, 1969). Wood (1974) provided contrary evidence in East Africa where only a small proportion of the

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[1] The instability of local markets is one of the key problems in the transition from subsistence to commercial agriculture (Abercrombie, 1961).

[2] The view of traders as exploitative has uncertain roots but bias against traders is an old theme, as shown in the case studies in Bohannan and Dalton (1962). Bias against private traders has also led the majority of African governments to establish monopoly control over the procurement and distribution of inputs. See the World Bank (1981b) for a discussion of the problems associated with government control of input supplies.

local markets in Kenya have been in existence for more than 40 years. Handwerker (1974) found, on the basis of interviews of 783 market sellers in Liberia, that the origins and changes in market places in Liberia were linked to changes in social organization. For an overview of the origins of local markets in Uganda, see Good (1970).

Much of the literature by economic geographers on the spatial organization and evolution of market networks has focused on the utility of central place theory for explaining patterns of rural development (C. A. Smith, 1976a,b) and on the functioning of periodic markets. Most rural markets are periodic with the periodicity occurring on a fixed interval of days for each market. Some of the advantages of periodic markets are: (1) they are spatially distributed so as to reduce the distance traveled; (2) enough people attend markets to make a trip worthwhile for traders and assemblers; and (3) periodic markets often serve as an initial collection point for the flow of food to towns and urban centers. E. P. Scott's (1972, 1978) studies in northern Nigeria illustrated the role of periodic markets in linking exchange systems and in stimulating regional economic development. Additional studies of periodic markets are McKim (1972), J. B. Riddell (1974), and R. T. Smith (1978).

An important concern in ethnographical studies has been the relationship between marketing, social relations, and who gains and who loses as a larger percentage of agricultural production is sold. A widely cited collection of 20 essays analyzing the impact of marketing on production and social relationships is found in Meillassoux (1971). Raynaut's (1973, 1977) studies of millet exchange at the village level in Niger stressed the relationship between markets, class formation, and wealth. In general, anthropologists have emphasized how commercialization of agricultural production and marketing undermines village social structure and promotes class conflict.[1/]

Competitiveness and Efficiency of Local Trade

Research on the economics of private trade and local markets began to receive substantial attention in the mid-1960s. Most of the research on private trade has used case studies to evaluate marketing costs of the flow of food from rural to urban centers and the extent to which markets are constrained by imperfections and inefficiencies such as too many intermediaries, inadequate infrastructure, barriers to entry, exploitive pricing practices by middlemen, and excessive variability in quality and quantity of supply.

The efficiency of distribution systems which rely on a long chain of small traders received early attention by researchers because many policy makers contend that a long chain of middlemen increases marketing cost. But research has shown that the length of

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[1/] This view has also been frequently expressed by some French researchers such as Kohler (1971) and Ancey, Michotte, and Chevassu (1974).

the chain is a false issue because the number of intermediaries involved in retail food trade in rural areas is generally limited to farm families themselves or at most two to three intermediaries (Thodey, 1969; W. O. Jones, 1972; Whetham, 1972). Trade in staple foods destined for urban centers may involve several intermediaries but is often conducted separately from local trade, occasionally even in a separate market place (Bauer, 1954; Whetham, 1972). Several researchers also have argued that the long chain of traders leading to urban centers in most countries is an efficient use of available resources (CILSS/Club du Sahel, 1977; Wilcock, 1978).

The process of price formation through "haggling" has been of particular interest to researchers, especially anthropologists. While low incomes of both farmers and traders make the potential gain from haggling attractive, the importance of haggling appears to have been greatly overemphasized by researchers. In most cases, both buyer and seller have a reasonably good idea of the range of prices prevailing in the market on any given day. Thodey (1969) and Gladwin and Gladwin (1971) have shown that this range tends to be considerably smaller for traders dealing in larger units, reducing the impact of haggling on major transactions. Whetham (1972) noted also that buyers and sellers are often well known to each other and that final bargains reflect degrees of kinship and social obligations as well as estimates of the equilibrium price.

The most important issue in the market imperfection debate has been the extent to which traders influence prices through collusion, manipulation of weights and measures, and misreporting of market information. Collusive practices are often attributed to the presence of groups which are organized along product lines such as the Hausa who control Kola trade (Lovejoy, 1973) and livestock trade (Cohen, 1971) throughout West Africa. Support for the belief that markets are subject to collusive practices is found in Bauer and Yamey (1959) who showed a positive correlation between producer price and the number of buyers in northern Nigerian peanut trade. In his landmark study, Bauer (1954) contended that some barriers to entry can stem from tribal affiliations and trader groups which regulate prices and establish conditions and fees for entry. Anthonio (1968) argued that a shortage of stalls in Ibadan markets allowed yam wholesalers to set prices above competitive levels. In an insightful article, M. P. Miracle (1968) argued that price formation among farmers was competitive in West Africa but that there were large departures from competition in the distribution system for all major products beyond local assembly markets. Miracle argued that even markets with large numbers of buyers and sellers may be influenced by cartelization and that cartels wield monopsony and monopoly power through their control over capital resources. In Miracle's view, there was considerable collusion among traders of seasonal commodities which can be stored and of non-seasonal commodities (e.g., Kola) not locally produced.

W. O. Jones (1972) challenged the validity of many of the studies reporting market imperfections in an important analysis of staple food marketing in Nigeria, Sierra Leone, and Kenya. The study was designed to provide a definitive account of price formation and the role of food sheds in serving urban markets. In addition to impressions gained through personal interviews, three major tests of marketing efficiency were used to evaluate the extent of market imperfections: (1) bi-variate coefficients of correlation of prices were calculated to test whether prices in nearby markets move together, reflecting the extent of market integration; (2) price differentials between markets were assessed in comparison to transportation costs; and (3) seasonal price fluctuations were compared with storage costs. Jones found in his study[1/] that (a) inadequate physical infrastructure did not appear to restrict marketing; (b) there was no evidence that producers and consumers are exploited by middlemen; (c) there were few signs that family ties impair functioning of markets; (d) market entry appeared to be relatively unrestricted; (e) marketing chains tended to be short; but (f) markets were weakly integrated. Jones concluded that governments should restrict their role to improving the integration of markets and the ability of markets to respond to changes in demand and supply. The major findings presented in Jones (1972) are reviewed and assessed in Jones (1980a).

W. O. Jones' finding that rural markets in Africa are weakly integrated has been noted in other studies throughout Africa. Ongla (1978), for example, in a case study of markets in Yaounde, Cameroon found significant price variations between markets and that problems in transportation were the primary cause of high marketing margins. Despite widespread evidence of weak market integration, most of the research carried out in the 1970s supported both Jones' conclusion that African marketing systems are reasonably efficient and competitive in the face of numerous obstacles and his policy recommendation that governments should restrict their role to improving marketing intelligence and roads (Hays, 1975; CILSS/Club du Sahel, 1977; Ejiga, 1977; Ongla, 1978; Hays and McCoy, 1978; Southworth, Jones, and Pearson, 1979; Berg, 1980). This point of view is forcefully presented in the recent World Bank report which states "The central problem in marketing and input supply is the very general tendency to give too large a set of responsibilities to public sector institutions, and too few to other agents--individual traders, private companies, and farmers' cooperatives" (1981b, p. 58).

The findings of neoclassical economists such as W. O. Jones, Ejiga, Hays, and others were generally unchallenged until Barbara Harriss' (1979b) devastating critique questioned the relevance of the neoclassical paradigm and raised several important questions about research methodology. Specifically, she contended that (1) correlation coefficients are an

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[1/] Jones' study is primarily based on fieldwork carried out by V. Q. Alvis, P. E. Temu, E. H. Gilbert, R. J. Mutti, D. N. Atere-Roberts, and A. Whitney.

inadequate tool for demonstrating either market integration or competition;[1] (2) the simplifying assumptions made in analyzing marketing margins over time and space were very crude, leading to problems in interpreting results; (3) that the majority of economic analyses of agricultural marketing have displayed a "serious lack of logical relationship between the data presented and the conclusions derived;" (4) attempts to synthesize the conclusions of various studies, such as by Jones (1972) and Berg's synthesis of a report prepared for the Club du Sahel (CILSS/Club du Sahel, 1977) seem to be guilty of oversimplification;[2] and (5) the "fetishism of competition" which has dominated African marketing research is ideologically motivated: it is anti-interventionist and pro-infrastructural. Harriss concluded that preoccupation with the debate over the competitiveness of rural markets has diverted attention from the structural interrelationships between production, exchange, and consumption. She urged future research to devote more attention to structural factors such as the extractive role of markets.

In summary, most efforts to evaluate market performance through an analysis of inter-market and inter-seasonal price movements indicate that private trading systems do suffer from the following imperfections: (1) high transaction cost due to lack of information; (2) high physical handling costs due to inadequate transportation infrastructure; (3) instability in supply channels is pervasive since there tends to be little control over weather, disease, and storage losses; and (4) lack of product homogeneity. But collusive practices do not appear to be widespread and there is little or no evidence that either cartels or monopsonistic buyers at assembly markets exert a significant downward pressure on producer prices.

In our judgement, Barbara Harriss (1979b) is correct in her observation that the debate over governmental control versus private traders has directed attention away from research on the range of political economy factors that affect the role of marketing in the development process. Research by neoclassical economists on market imperfections and inefficiencies has frequently generated few policy relevant conclusions because it has relied too much on idealized models. More attention needs to be given to the interrelationship between agricultural production and marketing in a dynamic context, examining the linkages between production, assembly, processing, distribution, and consumption. J. Sherman's (1981) research in Upper Volta represents a promising start in this direction. Marketing research within the political economy framework outlined by

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[1] Moreover, Harriss (1979b) showed that in several cases the correlation coefficients reported by Anthonio, Gilbert, Ejiga, and Hays were low and in some cases negative, and that they were in general based on weak data.

[2] B. Harriss (1979b) supported her position by citing several instances in which specific findings reported by country researchers presented a much less optimistic picture of the functioning of rural markets than reported in later volumes summarizing a number of country studies.

Wilcock (1978) and the social-institutional analyses by French researchers (e.g., Raynaut, 1977; Kohler, 1971) have provided insights which complement research carried out within the structure-conduct-performance paradigm.

Livestock Marketing

Trade between herders and farmers is one of the oldest forms of exchange in sub-Saharan Africa. Herders specializing in cattle historically have relied on sedentary farmers for their staple grain which is usually millet. This exchange has taken several forms, including (1) informal trade around watering and camping places in the Sahelian zone, (2) permanent market places in the Sudanian zone, and (3) reciprocal arrangements between farmers and herders involving rights to grazing, passage, and manure as well as grain and livestock products. While formal market exchanges have increased in recent years, trading arrangements have broken down as population pressure has forced farmers to move into areas traditionally used by herders and as nomadism has given way to sedentary herding.

Over the last 15 years, West African governments have struggled with the basic livestock marketing policy question of whether they should stress improvements in traditional processing and marketing systems or should they invest in slaughter plants in producing zones and in the transportation and distribution of fresh and chilled meat.[1/] Unfortunately, research on livestock marketing has been a low priority for economists and answers to this question are just starting to emerge. Some of the early studies by economists include: Aldington and Wilson's (1968) study of beef marketing in Kenya and Ferguson's (1976) study in Nigeria.

Complementarities between cattle breeding and livestock production in the savannah zone and meat markets on the West African coast have given rise to long-distance trade in livestock (A. Cohen, 1965; Couty, 1977). Population and income growth have led to increasing demand for cattle in the southern forest zones where livestock production is limited by the tsetse fly. Since urban markets for meat on the coast of West Africa are long distances from arid and semi-arid production zones in the interior countries of Chad, Niger, Upper Volta, and Mali, it is necessary to transport cattle, or alternatively meat, to the coastal markets. In West Africa, historically cattle have been moved to urban markets by trek (on foot) but recently cattle have been shipped in trucks and by railroad because it was assumed that trekking resulted in large weight losses in cattle and often death as cattle moved through tsetse zones on their way to coastal markets. Abner Cohen

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[1/] The basic policy issue is more complex because it involves determining the appropriate mix of state and private market involvement in trade. It is not a case of pure government control versus free trade although many researchers have talked in such terms (John Staatz, personal communication).

(1965), an anthropologist, examined the role of a network of Hausa dealers who moved around 75,000 cattle a year some 600 miles from northern Nigeria to Ibadan. As part of a major CRED study of livestock marketing in West Africa,[1/] Staatz (1979) studied long-distance cattle trade between producing zones in Upper Volta and Mali and consuming centers in the Ivory Coast. Surprisingly, Staatz found that, depending on the time of the year, quality of the grass, the state of health of animals, and the speed at which cattle are trekked, weight losses of animals which had been trekked 400 to 800 miles to market could be quite low. Staatz also showed that margins for cattle merchants and butchers were relatively small, and that a lack of market infrastructure did not hinder the market forces to regulate supply and demand. Staatz also studied the location of slaughter plants and found that it was more profitable for producers to slaughter cattle in the consumption zones on the West African coast rather than in the interior producing zones in Mali and Upper Volta because of the lack of local demand for by-products.

Trekking has also been the major means of marketing cattle in Eastern and Southern Africa. Sanford (1977) noted though that trekking is in danger of dying out in Botswana. Cattle corridors have also come under pressure in East African countries such as Kenya due to increased population and expansion of farming. Researchers such as Staatz and Sanford generally agree that governments should attempt to facilitate trekking by marking corridors and establishing water points.

Some researchers are starting to take a subsector approach in their analysis of production, marketing, and processing rather than studying marketing in isolation. Holtzman, Staatz, and Weber (1980), for example, recently evaluated the livestock production and marketing subsystem in the Northwest province of Cameroon. Ruigu (1978) similarly has analyzed the milk producing subsystem in Kenya. We think that this type of research should be expanded.

Fish Marketing

While it is not uncommon for farmers to fish on a part-time basis, most of the fish consumed is supplied by individuals who specialize in fishing. Frequently, an entire village or groups of villages near major lakes and marine fisheries are "fishing villages," relying on market exchange to obtain their staple grain. In most cases, fishermen sell their fish to traders as soon as they are landed and traders are responsible for drying the fish and getting them to market before they spoil. In many places, such as the Lake Chad basin on the borders of Niger, Chad, Cameroon, and Nigeria, traditional fish distribution systems have been active for decades (Couty, 1964; Couty and Duran, 1968). The prosperity of

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[1/] Follow-up studies on livestock marketing in West Africa are presented in Ariza-Nino and Steedman (1979, 1980).

this trade appears to have fallen in recent years due to such factors as falling yields, increased supplies from marine fisheries, and an expansion of frozen fish marketing in urban centers (Couty, 1977). Spoilage rates are often quite high in traditional fish marketing channels, necessitating large marketing margins. Hoffman et al. (1974) showed, for example, that most species of East African freshwater fish spoil within 24 hours if they are not dried or frozen.

One of the best approaches to improving the productivity and profitability of small-scale fishing is to focus on improved vertical coordination of fishing, fish processing, and fish marketing. Unfortunately, there has been little research on the efficiency of traditional drying methods or on the economics of alternative marketing strategies. Krone's (1970) analysis of frozen fish marketing in several West African countries showed it is unlikely that local fisheries would benefit from the adoption of frozen preservation techniques. Krone reported that the prices of smoke dried fish are cheaper than frozen fish and that fish marketing margins vary considerably, often accounting for 50 percent of consumer prices.

Valuable insights into the marketing strategies used by fish traders were provided in a series of studies in Ghana. Gladwin and Gladwin (1971) evaluated fish sellers' decisions on the Cape Coast in terms of the expected profits of sales in alternative markets. Later C. Gladwin (1975) used a hierarchial decision model to predict decisions about when and where fish sellers market their fish. Gladwin's approach is based on the view that sellers make decisions sequentially rather than simultaneously, weighing advantages and disadvantages (profitability) of alternative markets. Traders know by experience which markets usually entail the greatest risk but they do not know what the prices will be on any given day in distant markets. Therefore, traders consider markets in terms of increasing levels of risk and go to the least risky market in which it is expected that all their expenses will be covered. Gladwin also pointed out that since there is no storage at markets and the quantity brought to markets is necessarily predetermined, the price received on any given day will be determined solely by demand. Gladwin's hierarchial model was able to predict the decision about when and where to market in 90 percent of the cases for which it was tested in 1973. Quinn (1978) studied the behavior of marketing women in a village only 12 miles from the one studied by the Gladwins in Ghana. Quinn acknowledged the predictive capability of C. Gladwin's model but disagreed with the thesis that marketing women form conditional probabilities in making their decisions. Rather, Quinn argued, most fish retailers subjectively introduce heuristics that eliminate the need for recall, summarization, and computation. The main implication of Quinn's amendment to the C. Gladwin model is that strategies of market women are more sensitive to risk than indicated by Gladwin.

Transportation

Africa's rudimentary transportation network poses one of the major constraints on the distribution of agricultural commodities and the integration of African economies. Commodities are generally transported to local assembly markets using headloads, baskets, bicycles, and donkeys. Transport by animals is gradually giving way to trucks. Transportation problems are particularly severe in countries such as Mali, Niger, Chad, and Mauritania with vast land areas and roads that are often impassable during the rainy season (Grolleaud and Kohler, 1979). Because of the poor infrastructure, much of the value added in retail prices of agricultural commodities, particularly food grain, is due to transportation costs. Whetham (1972) contends that transportation may be the largest single item in trading costs. Sorenson et al. (1975) estimate that by the time maize has travelled 60 kilometers from a village in Zaire, its price has increased by over 25 percent because of transportation costs. Larger margins are not uncommon with farm gate prices frequently being as little as half the price found in nearby assembly markets and towns.

Studies of transportation costs in sub-Saharan Africa must be location-specific. For example, Thodey (1969) compared rates per ton/kilometer over 18 different routes in Ethiopia and found that charges on the highest cost route were over six times those of the lowest cost route. Inability to secure backhauls is considered to be a major problem throughout Africa. Probably the greatest influence on cost other than distance, however, is the condition of the road. Thodey (1969) estimated that even under the assumption that an all-weather road serves ten kilometers on either side of the road, only 10 percent of Ethiopia was served by year-round roads.

There is little hope that transportation problems will be alleviated in the foreseeable future. Rail and barge rates tend to be significantly lower than truck rates but few locations are served by these modes. Clearly, transportation infrastructure should be a major item on the agenda of African governments and donor agencies over the next 20 to 30 years. One of the critical problems is that African governments often underfund recurrent costs to maintain the roads which are often built with foreign aid. Peter Heller's (1979) "Underfinancing of Recurrent Development Costs" and the CILSS/Club du Sahel's (1980b) report on recurrent costs should be closely examined.

Processing

A wide range of processing technologies with varying factor intensities and technical efficiencies is available in most countries. Most research on processing has been undertaken by consulting firms in the form of feasibility studies for governments and donor agencies. Unfortunately, many of these hastily conducted feasibility studies have been carried out by engineers and management consultants who assess the private

profitability (financial returns) of the new technology to the individual firm while ignoring transportation and handling costs and the equity (employment and income distribution) consequences of alternative processing techniques. Another shortcoming of many studies is the failure to compare alternative processing techniques. For example, studies of rice processing in West Africa by Tempelman (1972), Oni and Olayemi (1975), Rosenboom and Parker (1975), and Goodwin (1975) analyzed costs and returns of only one processing technique.

The two major issues in processing research are the efficiency and equity effects of alternative techniques. One of the first studies to deal with these two questions was W. Miller's (1965) analysis of five palm oil processing technologies in Nigeria--hand processing, the small screw press, the small hydraulic hand press, the intermediate mill, and large capital-intensive mill. The study revealed that there was a large difference in labor and capital intensity of the technologies. Capital investment per firm in 1964 ranged from $11 in hand processing to $156,000 for the capital-intensive mill. Hand pounding was less technically efficient but more economically profitable than alternative technologies because of (1) lower transportation costs, (2) lower priced family labor, and (3) more consistent use of fruit with a high oil content. For an exchange of views on Miller's findings, see Kilby (1967), Purvis (1968a), and Kilby (1968, 1969).

Miracle (1966) reported that hand pounding maize with mortar and pestle is the primary processing technique used for maize throughout sub-Saharan Africa. Miracle cited studies of maize pounding in Angola, Malawi, and Sudan which showed that an average of 12 to 13 hours was needed to pound 30 pounds of maize. Since this yields an estimated four to five days' worth of food, women must spend three or more hours a day in pounding their family's daily grain intake. In light of this time commitment, Miracle stated that it is not surprising that "Africans are quick to adopt grinding mills wherever they can be obtained."

An important issue in the choice of processing techniques--consumer taste--was addressed by Francis Stewart (1979) in a study of maize processing in Kenya. Stewart found that small-scale hammer mills were far superior to large roller mills in terms of employment and surplus generated but they were not competitive because the flour produced by the small mills was considered inferior by consumers to the flour produced by the large mills. Stewart attributed the demand for high quality flour to advertising by large flour mills and because of a skewed income distribution which induces a demand for higher priced flour.

Eastman (1980) has compared hand pounding versus mechanized hulling and grinding in a report on a new flour milling system in Botswana, Ghana, Nigeria, Senegal, and Sudan.

Eastman argues that the advantages of mechanized processing include (1) the demand for sorghum and millet flour will increase if a flour with acceptable taste, texture, and color can be developed; (2) mechanical processing is needed to meet urban demand for more highly processed foods; (3) time spent on hand pounding--2 to 3 hours a day per family--could be more profitably spent on other activities; and (4) flour produced with dry milling techniques has a longer shelf-life than those produced using traditional wet milling processes. But Eastman acknowledged that mill ground flour has a lower nutrient content--25 percent less fat, 10 percent less crude fiber, 15 percent less ash, and slightly lower protein--than flour produced with hand processing methods. A weakness of Eastman's assessment is that he underplays the potential loss of income-earning opportunities of those currently engaged in hand pounding.

The argument that mechanized processing displaces labor engaged in hand pounding was challenged by Uhlig and Bhat (1979) in their study of maize milling which drew primarily on Kenyan production patterns and price relationships. They contend that because capital-intensive techniques are associated with an increase in scale and capital expenditure, primarily to serve urban markets, large mills do not actually displace labor. While Uhlig and Bhat provide a framework for evaluating alternative techniques for processors oriented toward urban food sheds, based on flour quality and production rates as well as technical efficiency, they assessed only the private profitability of alternative techniques, and failed to consider transportation and handling costs, and equity issues.

Emmy Simmons (1975) studied food processing and preparation among Moslem women in villages in northern Nigeria. She noted that home food processing and preparation provides employment for thousands of rural people in northern Nigeria--primarily women. Since the women are in purdah, the prepared food is sold by their children in the villages. While women only earned 3 to 9¢ an hour in processing, the return on invested capital generally ranged from 16 to 40 percent because of the low initial investment. With 90 percent of the women in the villages studied engaged in food processing and preparation, Simmons was concerned over the possible loss of employment opportunities as modern processing replaced home processing.

The definitive study of processing in Africa is an analysis of the choice of rice processing technology in Sierra Leone which was carried out under the direction of Dunstan Spencer and reported in Spencer, May-Parker, and Rose (1976). The Spencer study broadened Timmer's (1972) framework for studying rice processing in Indonesia by incorporating the costs of assembling raw materials from farmers prior to processing and the costs of distribution of the final product to consumers throughout Sierra Leone. Spencer's research team collected engineering and socioeconomic data throughout Sierra

Leone on all rice processing technologies in use in 1973-74. A surprising finding was the relatively high technical efficiency of hand pounding of rice, a finding which has been underplayed by salesmen of modern processing plants, and by some donors. The technical efficiency (pounds of clean rice per hundred pounds of husked rice) was found to be 68.4 percent for hand pounding; 67.5 percent for small steel cylinder mills; 70.0 percent for small rubber roller mills; 64.0 percent for large disc sheller mills; and 72.0 percent for large rubber roller mills.

Spencer fed the technical data into an LP model to generate information on the output, employment, imports, exports, and foreign exchange effects of each of the five technology options. The surprising finding was that if the government's 1974 policy of subsidized interest rates (10 percent) were allowed to continue, then machine processing would rapidly replace hand pounding which would lead to a large displacement of female labor, estimated to be 40,000 person years of employment. This is a staggering figure in a small country with a total population of about three million people. Spencer concluded that no one processing technique but rather a combination of hand pounding and small-scale mills would be appropriate depending on the location (i.e., the wage rates and transportation costs) in the country. Spencer's work will be a standard reference for years to come; it demonstrates how to generate information on which technology is appropriate for processing rather than advancing facile statements that Africa needs appropriate technology.

Storage

Three issues have stimulated research on storage over the past ten years: urbanization, drought, and growing food imports. Research on storage is sparse and largely impressionistic. The common impression is that storage losses are around 25 percent even though, as we shall see, the actual figures can range from 3 to 40. For an overview on storage, see National Research Council (1978).

Methodological Issues

Estimation of on-farm storage losses is as much an art as a science. The National Research Council (1978) defines "loss" as a measure of a reduction in weight in the amount of food available for consumption. Losses are distinguished from damage, with the latter being a measure of the proportion of grain having been infested, broken, or molded. One of the main problems in deriving reliable estimates is that losses in traditional storage vary considerably by rainfall, type of grain, and type of storage. For example, losses tend to be higher in humid areas and when grain is stored in houses rather than in separate granaries where insecticides can be used. Another problem is the lack of a standard approach for determining when damage is so extensive that grain cannot be

consumed. A final problem is the sampling procedure by which grain is selected for testing. Weighing the grain in an entire granary is clearly not feasible. Exposure of grain to open air during the process of weighing will bias subsequent weighings since exposure affects the rate of insect infestation. Guggenheim (1978) found that the degree of insect infestation in household granaries in Mali was much greater near the exposed surface than in grain near the center of the granary. There is clearly a need for some consensus on procedures to follow in estimating losses (J. M. Adams and G. W. Harman, 1977). See FAO (1980) for an overview of methods for assessing post-harvest food grain losses.

On-Farm Storage

The greatest proportion of national grain stocks in most countries is held by rural households. Granaries are often little more than a section of the house in which a family lives. Most grain is stored in containers ranging from mud-brick silos to woven straw granaries. While grain for consumption is generally kept in large containers, often raised off the ground, seed grain is frequently sealed in gourds or clay containers and kept in the house. The volume of cereal stored is largely determined by decisions made by family members. Little is known about the volume of holdings, physical weight losses by crop and by ecological zone, time release patterns, investments in storage facilities, and techniques for minimizing storage losses (CILSS/Club du Sahel, 1977).

Guggenheim, an anthropologist, describes an on-farm storage system among the Dogon people in Mali in "Of Men, Millet and Mice: Traditional and Invisible Technology Solutions to Post-Harvest Losses in Mali" (1978). Guggenheim found that the Dogon stored millet left on the head for up to four years. Storage losses by weight were found to be extremely low--less than 5 percent--because of the low humidity, design of granaries, use of fumigants such as ashes and smoke, constant inspection, and rotation. Hamilton (1975) described two major types of traditional storage in Botswana, including mud/wattle cribs and reed and grass baskets but these methods have largely given way to storage in jute bags.

Grain storage in Tanzanian villages is influenced by the socioeconomic position of the family. In high-income farming households nearly all grain is stored in jute bags in unoccupied rooms, often with concrete floors. Woven reed containers (1/2 to 3/4 ton capacity) are used to store rice. Poor farmers generally store their maize piled on a ceiling platform in the house, usually above the kitchen fire. While losses are high in this system, the expense required to construct an elevated, free standing granary called a dungu could not be justified in light of the small harvests of poor households.

Studies by Hays (1975), Hays and McCoy (1978), and Ejiga (1977) in northern Nigeria are among the first studies of on-farm storage by economists. Hays found that 80 percent

of millet and sorghum produced in the area studied was stored on farms for later consumption. Eighty-five percent of the households owned at least one dried earth granary (rumbu, pl. rumbuna) and the remaining households stored grain in their houses. Hays found that the capacity of rumbuna ranged from 2.5 to 3.2 metric tons and slightly exceeded the minimum annual requirements of a rural household. Hays (1975) also found that while timing of sales was dictated by the need for money two-thirds of the time, there was little evidence of post-harvest distress sales. A major finding by Hays is that on-farm storage losses of millet and sorghum were extremely low--3 to 4 percent--because of the low humidity in the savannah environment in northern Nigeria. But in the same environment, Ejiga (1977) found that the damage due to insect infestation of cowpeas was 35 percent of stored grain. Although there is some promising research underway to reduce on-farm storage losses--storage in black plastic bags--high insect damage is a major constraint on the cowpea production. Kamuanga and Spencer (1981) found in a study of 30 farmers in the Office du Niger irrigation scheme in Mali that the post-production losses of rice were as follows: grain not harvested and left in fields, 6 percent; machine threshing, 3 percent; household storage, 9 percent; and hand pounding and processing, 2 percent; giving a total of 20 percent.

Off-Farm Storage

Cereals are stored in off-farm facilities for four general purposes: (1) pipeline stocks for milling and distribution, (2) interseasonal storage to stabilize intra-annual supplies and prices, (3) buffer stocks to stabilize inter-annual supplies, and (4) emergency reserves. In most countries, these functions are being shared by private traders and public agencies. Off-farm storage facilities include bag storage and bulk silos. Grain is usually stored in jute bags if it enters the market. Little grain is handled in bulk due to a lack of infrastructure.

Public storage of food grains has historically been of little importance because of the small percentage of people living in cities and the token volume of grain imports. But the need for public sector storage changed overnight during and following the 1968-74 drought in the Sahel and Eastern Africa. All Sahelian countries have now assigned the procurement and management of cereal storage to either autonomous public agencies or to existing government departments. The need for public storage is obviously influenced by the proximity of a country to surplus supplies. Reports by the CILSS/Club du Sahel (1977, 1979) and Grolleaud and Kohler (1979) argue, for example, that interior Sahelian countries must take a different approach toward public storage than coastal countries. For countries such as Niger, six months can pass between donor agreement to ship food and the delivery of assistance. Coastal countries, on the other hand, can afford to hold

smaller reserves. Hamilton (1975) points out that a country such as Botswana has less need for public storage because it has access to food from surplus-producing countries in the region.

Public investment in off-farm storage of food grain represents a major cost. The cost of accumulating and renewing stocks is influenced by the quality of off-farm storage facilities. In order to minimize the cost of buffer stock and emergency reserve programs, storage facilities are needed which enable grain to be held for two or more years. Unfortunately, the loss record on long-term government storage has been poor (Berg, 1980). The FAO (1981b) has recently completed a study for the CILSS/Club du Sahel of the cost of building and maintaining a comprehensive grain storage system for the Sahel.[1/] The report has touched off a debate among donors and there are many critics who question the need for the system and further question the wisdom of donors paying for most of the annual $14-15 million cost of maintaining the scheme. The World Bank questions buffer stock schemes by noting "buffer stocks are an expensive and risky road to food security" (1981b, p. 69).[2/]

Storage Costs

While storage cost estimates must be treated cautiously, some general observations can be made about the costs of storage in on-farm granaries, bag warehouses, and bulk silos. Where significant bulking and transfer is not needed, traditional storage will most likely be the least costly. Bag warehousing is often the least expensive when the grain must pass through a number of intermediaries and be transported via a number of different modes. But for long-term storage, net costs per ton are often lower in modern silos than in warehouses using bagged storage (Grolleaud and Kohler, 1979).

Wilcock (1978) and Sorenson et al. (1975) propose that the least cost approach to storage is often one that relies on a combination of different storage techniques. If village level stocks are desired, either by private traders to facilitate inter-temporal price arbitrage or by public agencies as a local buffer stock, improved granaries similar to

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[1/] The study outlines a strategy for the establishment of a coordinated system of national and regional reserve stocks. The national stocks are envisaged to be held by the respective governments while the regional reserves would be owned by CILSS and overseen by a new body within CILSS--the Regional Grains Divisions. The FAO study suggests that a total grain reserve of 465,000 tons should be established which would require an additional 272,500 tons of storage to be constructed in the Sahel at a cost of US $105 million. The annual operating cost for the grain reserve system is estimated to be $14.9 million--most of which would need to be financed by donor contributions.

[2/] The World Bank (1981b) notes that the annual cost of buffer stock schemes may amount to 15 to 20 percent of the value of stocks because stocks need to be turned over every two to three years in order to avoid deterioration, and that administration of these schemes is demanding.

those used at the farm level will generally be the lowest cost option. The bulk of stocks for long-distance trade, intra-annual stabilization schemes, and for interregional transfer to deficit areas could be held in bag warehouses. Finally, stocks held for inter-annual price and supply stabilization and for emergency shortfalls could be held in bulk silos.

Storage Losses

The main empirical findings are: (1) on-farm losses of millet and sorghum are quite small--often under 5 percent annually--in the low humidity savannah regions, (2) losses of maize are low in Eastern Africa, but high (30 to 40 percent) in the rain forest area in West Africa, and (3) losses in publicly operated warehouses generally are much higher than traditional on-farm granaries. In summary, losses by weight are often lower than the 25 percent figure frequently cited by the FAO but damage from insect infestation--especially cowpeas--is extremely high with 30-50 percent figures being common.

Storage losses of perishable staples are high: cassava, yams, sweet potatoes, white potatoes, taro, bananas, plantains, and breadfruit. Booth (1974) reports that post-harvest losses of tropical root crops are enormous. The main problem with storing roots and tubers is that they have a high moisture content relative to grains and they continue to respire and metabolize at a faster rate than cereals. Research on storage of perishables should receive increased attention. The inability to store and transport perishables constitutes a major constraint on increased specialization of production.

Improvements in Traditional Granaries

Even though storage losses in traditional granaries are lower than had been previously assumed, losses of even 5 to 10 percent may be significant from the perspective of an individual household. Nevertheless, it is not clear how much room there is for improvement of traditional storage. Hays (1975) argues that there is limited scope for reducing losses in northern Nigeria because of the cost effectiveness of the traditional rumbu. Many researchers have argued that selective use of insecticides in on-farm granaries can reduce insect losses. Increased crib drying has been successful in reducing losses in the humid regions of West Africa and Zambia (National Research Council, 1978).

Credit

Credit is an important political and economic topic in Africa and other regions of the Third World. It is also a lively topic for donors. Dale Adams and Douglas Graham (1981) recently pointed out in their impressive state-of-the-art paper that in the past several decades foreign donors have spent in excess of $5 billion on agricultural credit projects in the Third World.

In contrast to other regions of the world, rural financial markets in sub-Saharan Africa are dominated by informal lenders, including merchants, traders, friends, relatives,

and money lenders. A major reason why rural people rely heavily on informal rather than formal sources of credit is that many loans are used for consumption purposes such as ceremonial obligations and school fees (Vasthoff, 1968; Miller, 1977). In fact, numerous studies have revealed that nonfarm use of credit generally accounts for over half of the funds borrowed. Osuntogun's (1980) study of 220 small farmers in the cocoa zone in western Nigeria revealed that 60 percent of the credit received from the government financed cooperative credit scheme was used for nonfarm uses in 1977. Only a small portion (7.8 percent) of this total was used for ceremonial purposes while 42 percent was used to pay school fees of their children. Adegboye (1969) studied the "pledging" of assets such as cocoa trees as collateral for loans from informal borrowers and surprisingly found that children's education ranked first among reasons why Yoruba farmers in western Nigeria pledged cocoa trees for loans. The relative importance of loans for consumption purposes is often highly location-specific and seasonal in nature. For example, R. King's (1975, 1981) studies of credit in northern Nigeria revealed that most small farm loans were used to pay for farming inputs, including hired labor. For a literature review on credit in Africa, see L. Miller (1977).

Formal credit for agriculture has been generally channeled to relatively high-income areas, to export rather than food crop producers, and to classes in rural society who have land, power, and privilege. For example, Lele (1975) reports that in 1971 a total of 88 percent of the loans outstanding of the Agricultural Finance Corporation in Kenya had gone to large farmers. Moreover, in the early 1970s, smallholders in Kenya received 25 percent of short- and medium-term agricultural credit but they produced 50 percent of the marketed output (Donaldson and von Pischke, 1973). Also see Winch's (1976) study of rice production in northern Ghana and Kinsey's (1978) study of maize production in Zambia. The modest flow of formal credit for food production has been documented by Lele (1975), Miller (1977), and others. The issues and problems in rural credit and financial markets in Africa are similar to those identified by Donald (1976), and D. W. Adams (1978) and Howell (1980) in other regions of the Third World.

Theoretical Framework

The theoretical framework for the analysis of rural financial markets in Africa has been almost exclusively neoclassical with emphasis on supply and demand factors following the expositions of Bottomley (1963, 1975) and D. W. Adams (1978). Bottomley and Adams attempt to explain abnormally high interest rates for private loans in rural areas in terms of a premium for lender's risk (to cover the alleged high default rate) and other factors such as the greater administration costs to lend to small borrowers. A challenge to the neoclassical approach has come from Bhaduri (1977) in his Marxist

analysis of interest rates in precapitalist agriculture in India. Bhaduri notes that official government credit surveys in India have substantially underestimated interest rates paid by farmers because some of the interest paid is concealed in various modes of repayment in kind. In Bhaduri's model, he examines how the lender himself influences the default rate through his selection of the interest rate to be charged and the valuation on the collateral to be offered but he presents no data to test his model. Recently, Von Pischke (1980) urged neoclassical economists to broaden their theoretical orientation and examine credit within a political economy framework.

Informal Lenders

Money lenders, traders, farmers, and other informal lenders play a major role in supplying credit to small farmers because they generally will provide loans on short notice, often require little or no collateral, and tend to place few if any restrictions on how funds can be used. But the average amount of each loan is small. Longer-term loans and large loans usually require collateral or a guarantor. There has been a dearth of comparative studies of informal and formal lending institutions. Tapsoba's (1981) comparative study of formal and informal credit systems serving small farmers in eastern Upper Volta revealed that there were two types of informal lenders at the village level--noncommercial lenders who lent money without interest charges to members of families and friends and commercial lenders who lent primarily within the village and to a few people from neighboring villages. A study of small farmer credit in Mali by J. V. D. Lewis (1978) revealed that kinship and marriage networks are the foundation of group credit and that groups can mobilize capital and repay loans when individual members suffer from bad harvests, family illness, and death. For one of the few studies of the role of informal credit in long-distance cattle trade from northern Nigeria to Ibadan, see A. Cohen (1965).

Despite evidence that informal lenders fill a valuable role in supplying short-term credit in rural areas, money lenders have been widely condemned for charging exorbitant interest rates. The literature is full of assertions about money lenders charging 100 to 150 percent annual interest rates in Africa.[1/] Research in Sierra Leone by Linsenmeyer (1976) revealed that although the effective annual interest rate was 168 percent, the actual yield received by money lenders was 43 percent after deducting for late payments and defaults. This finding suggests that money lenders in Sierra Leone face high risk, notwithstanding their local knowledge of villages and their clients, and that risk is an important element in the high costs of capital (Byerlee et al., 1982). But this issue needs further research. The challenge for policy makers is to find out what can be done to

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[1/] For an important debate on money lenders in India, see Bhaduri (1977).

incorporate many of the desirable features of money lenders (e.g., lending for seasonal consumption needs) into formal lending programs.

Government Credit Institutions

A common response of African governments to the limited flow of credit to farmers from commercial intermediaries and to alleged usurious interest rates of money lenders has been to establish government credit institutions, generally in the form of national agricultural banks. Although these institutions enable funds to be directed toward target groups, they have generally been unable to recover enough of their loaned funds to continue operation without substantial financial subsidies. Tapsoba (1981) and other researchers argue that low repayment rates reflect a widely held view among borrowers that government credit is a gift.[1/] Agricultural credit banks have experienced several additional problems, including high administrative costs, poor coordination, inadequate supply of loanable funds, and poorly trained personnel (Von Pischke, 1980; Due, 1980, 1981).

Should Interest Rates Be Subsidized?

In order to reduce the power and influence of money lenders and channel more formal credit into agriculture, many African countries subsidize interest rates by charging only 6-12 percent annual interest rates on loans even though inflation is running at 10-15 percent per year.[2/] The policy of encouraging an expansion of rural credit through artificially low interest rates has been strongly criticized by D. W. Adams (1978) and D. W. Adams and D. H. Graham (1981) as being counterproductive because subsidized credit reduces the incentive to mobilize rural savings and prolongs the dependency on foreign aid for financing credit projects. Moreover, financial intermediaries tend to extend the bulk of their loans to large farmers in order to minimize their administrative costs. The net effect of artificially low interest rates appears to be one of helping larger farmers who often have poorer repayment rates than small farmers.[3/]

Although it is increasingly being recognized that low interest rates are counterproductive, few African countries have abandoned the policy of subsidizing interest rates.

[1/] There is much reality to this perception. For example, in May 1981, the government of Senegal announced that it was "writing off" all outstanding loans for seed and fertilizer and suspending the need for farmers to repay equipment loans until the financial records of the recently dissolved grain board--ONCAD--were put in order.

[2/] Research in the Third World generally shows that annual real interest rates of around 25 percent are needed to cover interest, default, and the administrative costs of small farmer credit programs.

[3/] But one must caution that there are virtually no hard data on repayment rates by size of farm in Africa.

Moreover, rural credit is more complex than the rate of interest. D. W. Adams (1978) and several authors in the excellent collection edited by Howell (1980) have shown that other factors than interest rates--ease of securing credit, the timing of credit, transaction costs, uncertainty about when funds will be delivered, and collateral requirements--often discourage small farmers from seeking loans from formal institutions despite low interest rates. For example, Miller (1977) found that 65 percent of 249 farmers surveyed in Nigeria said that they would be "willing" to pay 15 percent interest and that 20 percent would be willing to pay 30 percent interest rates on their loans. But these data must be treated with caution because they are based on hypothetical conditions.

The relative impact of interest rates, credit limits, and form of credit disbursement on small farmer net cash flows and farming patterns has been recently tested in an evaluation of a government credit program in the Cameroon. To test the on-farm effects of varying credit limits, interest rates, and other loan terms, Kamajou and Baker (1980) used LP to model small farm borrowers and found that (1) disbursements in kind had little impact on choice of production techniques but cash loans had a positive impact on farm output and income due to reduced requirements for cash reserve; (2) increased interest rates had little impact on the optimal solution, including pattern of land use, intensity of input use, and borrowing activities until interest rates exceeded 24 percent; and (3) increased credit limits are more important than interest rates in improving farm income because higher limits allow a reduction in required cash reserves, releasing cash for productive investments. The Kamajou/Baker study provides strong support for D. W. Adam's (1978) conviction that interest rates should be raised, taking into account the opportunity cost of capital.

Credit Components of Technical Packages

In light of the problems that governments have had in operating subsidized credit programs with their own field agents, many researchers have recommended that credit should be extended as part of a technical package administered by area and regional rural development programs.[1/] The crucial aspects of extending credit within area and regional rural development programs include a large number of micro-specific issues such as: (1) the soundness of the technical package, (2) the farmer's ability to implement the package, (3) supporting services, (4) the ability of the borrower to repay, (5) marketing opportunities, and (6) the system of reporting and control. Several micro-studies have shown that IRD programs addressing these issues have resulted in improved credit services to farmers and improved loan repayment rates (Belloncle, 1974; R. King, 1975, 1981). For

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[1/] Von Pischke (1980) proposed a general model of "supply-leading finance" whereby funds are made available to target groups in advance of demand in an effort to stimulate the adoption of proposed innovations.

example, Dennis Anderson (1975) found that credit default in the Lilongwe rural development project in Malawi was reduced by (1) increased participation of farmers in the credit allocation process, (2) tying credit and marketing, and (3) making dividend payments a function of village repayment rates.

In a recent study of a government credit program in eastern Upper Volta, Tapsoba (1981) found that the program was floundering after four years of experience. A total of about 1,200 four-year loans had been extended at 5.5 percent interest for small farmers to purchase oxen and donkeys and animal traction equipment. The collection ratio had varied between 22 and 54 percent and the percentage of portfolio in arrears has risen steadily from 2 percent in 1977 to 28 percent in 1980. The study shows that in the absence of a proven biological package for the staple foods--sorghum and millet--it is unwise to shower subsidized credit on farmers and encourage them to buy animals (donkeys and oxen) and animal-powered equipment. The government of Upper Volta appears to be putting the cart before the ox in promoting subsidized credit to step up food production in the Eastern Region. Unless there is an improved sorghum/millet biological package or the introduction of cash crops such as cotton into the farming system, the future of this credit program is in jeopardy.

Rural Savings

The importance of mobilizing rural savings as a source of loan funds has been stressed repeatedly in recent years. But most countries have not placed much emphasis on trying to mobilize rural household savings because it has been generally assumed that rural people are too poor to save. D. W. Adams, however, has argued persuasively (1978) that the substantial voluntary rural savings capacities exist throughout the Third World and that subsidized loans destroy the incentives to mobilize rural savings. Robert's study (1972) in Zambia shows that 239 of the rural households were reported to be saving more than 30 percent of their income. But Robert's data on average propensities to save and similar studies of rural savings have to be taken with a grain of salt because in most surveys savings are computed as a residual. A study of the informal savings societies by Haggblade (1978) in the Cameroon showed that the informal savings association led the establishment of a formal savings institution. For a survey of informal savings, see Alberici and Baravelli's (1973) survey of savings banks and institutions.

Policy Direction

Research on credit in sub-Saharan Africa has shown that credit programs can help small farmers, especially if credit is tied to profitable technical packages (usually export crops) and to marketing organizations which can deduct credit repayments from the sales of loan recipients. Credit programs for food production have frequently failed because of

weather instability (one crop failure in 5-8 years is not uncommon), unprofitable technological packages, corruption, mismanagement, and failure to communicate the terms of loans to farmers. The overriding problem in many countries in Africa is the lack of a profitable technical package for food crops and not the absence of credit. Credit programs for small farmers are difficult to implement and supervise even when a profitable technical package is available. Unfortunately, in many countries, government credit programs will continue to fail not because of the usual problems of mismanagement and corruption but because of the tendency for donor agencies to "move money" through credit projects ahead of a solid and profitable technical package--especially for food grains such as millet and sorghum--as illustrated by Barrett et al. (1982) in Upper Volta and other researchers. Adams and Graham sum up this dilemma by observing that "if these other problems are not properly dealt with, credit (subsidized or not) will not make any difference. Credit by itself cannot raise the rate of return on farm investments" (1981, p. 362).

Research Direction

Research on credit in Africa has been narrowly defined and has usually relied on one-shot surveys without probing into the social and political environment in which farmers and governments are operating. Research should move beyond the narrow neoclassical paradigm with its fixation on interest rates to a political economy framework which examines the economic, political, and institutional forces which influence the performance of rural financial markets and credit programs (von Pischke, 1980). At the micro level, research on credit should be incorporated into research on the total farming system and the agenda broadened to include formal and informal credit, consumption and production credit, and rural savings.

Cooperatives

Over the past 30 years, many Western development specialists have felt that cooperatives were "good" for developing countries. This theme is conveyed in papers in the volume edited by Anschel, Brannon, and Smith (1969). Moreover, in the postindependence period of the 1960s, it was widely thought by some African leaders such as President Nyerere (1967) of Tanzania that cooperatives could be established by building on traditional institutions of extended families and communal support systems. Finally, Scandinavian aid that has been made available for cooperatives in East Africa over the past 20 years is tied to the belief that cooperatives have performed well in Scandinavia and that this type of institution is good for Africa.

Cooperatives--especially for African smallholders--are in their infancy. For example, although the first cooperative society in northern Rhodesia (now Zambia) was

formed in 1914, the cooperative movement was an informal affair for Europeans until 1948 when African smallholders were invited to participate (Quick, 1978). Likewise, cooperatives for smallholders were first established in the 1930s in Tanzania and in Kenya as recently as the 1950s. Despite early optimism, the record on cooperatives has been one of almost uniform failure except in a few cases where they are involved in marketing an export crop such as tea, cotton, or tobacco. And failure has been a common denominator under civilian, military, capitalist, and socialist governments.

There is no shortage of explanations for reasons why cooperatives fail. Quick points out that "with a few exceptions most authors who study cooperatives advance a 'blame the peasants' view and assert that the failure of cooperatives lies in the culture, values and attitudes and habits of rural villagers who are asked (by the government) to form these institutions" (1978, p. xi). But as Quick points out, this is a naive view. For example, in 1965, President Kaunda enthusiastically launched a major campaign to develop cooperatives throughout Zambia as the cornerstone of the government's rural development program but seven years later "almost everyone in Zambia felt that the cooperative movement had been a costly and disappointing failure" (Quick, 1978, p. xi). The failure was not caused by cultural factors and attitudes of cooperative members but by a complex set of bureaucratic mistakes by the government's Department of Cooperatives.

Two collections of essays on cooperatives and rural development in East Africa edited by Widstrand (1971, 1972) identified the following reasons for the failure of cooperatives: (1) failure to appreciate the difference between African collective values and requirements for a formal cooperative; (2) insensitivity of government-initiated cooperatives to local conditions and social structure; (3) a widespread tendency for cooperatives to be dominated by wealthier members of rural communities; (4) excessive government control; (5) shifts in emphasis of government programs; (6) poor management; and (7) corruption. In an important study of cooperatives in northern Nigeria, Roger King (1975, 1981) attributes the failure of cooperatives to reliance on a top-down approach which is insensitive to local problems. Drawing on case studies in six villages, King contends that government policy should encourage the formation of different forms of cooperatives instead of introducing one type throughout northern Nigeria.

One of the most consistent criticisms of cooperatives has been that government-initiated cooperatives have tended to reinforce existing social structures or even to aggravate class divisions rather than act as a vehicle of equitable change. Miracle (1969) argued that equity among members and the protection of the interests of members can contribute to the success of cooperatives. But King (1981) argues that, in general, cooperatives are an institutional form that lend themselves to being used by wealthier

members in countries following a market-oriented policy of agricultural development. In Senegal, D. Cruise-O'Brien (1975) reached a similar conclusion in his study of small farmers and cooperatives.

Goran Hyden, a Swedish political scientist and one of the foremost authorities on rural development in East Africa, observed that problems of promoting cooperative organizations in Africa in large part stem from what Ekeh (1975) describes as a conflict between the moral imperative of the modern organization--the cooperative--and those of the primary social organization--the village, the clan, or the lineage. For example, in his study in Kenya, Hyden (1978/79) found that when there was a conflict over whether a cooperative leader should discharge his public responsibility to look after the cooperative or to "use" the cooperative for personal gain or the gain of his clan or village, unfortunately the latter prevailed in all too many cases. Hyden found in Kenya that "most leaders and followers consider it quite normal to 'use' the cooperative in order to strengthen the position of their clan or village." Hyden concluded that until African society becomes more differentiated and a new form of social stratification emerges "a wholesale introduction of cooperatives based on principles practiced in more developed countries is still far from being the solution to Africa's rural development problem" (1978/79, p. 57).

Cooperatives make heavy demands on the scarcest resource in rural Africa--skilled managerial and administrative talent. The years required to develop skilled manpower have been consistently underestimated. For example, when Tanzania's Second Five-Year Plan was released in 1969, the government announced that Tanzania would be self-sufficient in all levels of manpower by 1980--a target that may be achieved by year 2000.

In summary, the available evidence on cooperatives leaves little room for optimism. While governments will undoubtedly continue to support cooperatives on an ideological basis, there is no evidence to suggest that cooperatives are less exploitative or more efficient than the existing system of private trading and marketing. While cooperative authorities recognize that it takes 30-40 years to develop successful programs, this time frame falls on deaf ears of politicians who promote crash programs. Additional assessments of marketing and producer cooperatives can be found in Dumont (1966); Ellman (1977); Lele (1975, 1981); Lele and Candler (1981); Mensah (1977); Apthorpe (1972); and Feldman (1969). For references in francophone countries, see N. S. Hopkins (1976); Storm (1976); Martin (1976); Charlick (1980); W. I. Jones (1972); Wilcock (1978); Berg (1980); and Belloncle (1974). Tanzania's attempt to develop cooperatives over the past 50 years has been closely scrutinized in Hyden (1973a,b; 1978/79); Barker (1979); and Due (1980). For an analysis of Ghana's 30-year attempt to build cooperatives, see Miracle and Seidman (1968b); and Killick (1978).

Consumption

Consumption expenditures in sub-Saharan Africa (cash and consumed home production) are dominated by food and food consumption is dominated by cereal grains and tubers. Traditionally, millet, sorghum, and maize have accounted for well over 80 percent of the grain consumed. Sorghum and millet have been the primary staples in the arid zones of West Africa while maize has dominated diets in Kenya, Tanzania, and most of Southern Africa. Tubers, particularly cassava, are the basic staple in the humid forest zone of West Africa and in most of Central Africa. For an overview of consumption patterns by region, see USDA (1981, pp. 40-55).

Over the last several decades, food consumption patterns have been changing and are becoming westernized. There has been a distinct shift in consumption toward rice and wheat flour throughout Africa, particularly in urban areas.[1/] Because there are many areas where wheat and rice cannot be profitably grown, the rising demand for these commodities has been translated into dramatic increases in imports. The FAO (1978) reported, for example, that wheat imports in all of Africa trebled between 1962-64 and 1972-74. As a result, many countries have tried to reduce food imports, especially rice and wheat, through taxation, subsidies, government edicts, and accelerated food production programs. For example, the government of Senegal is forcing bakers to incorporate 20-30 percent millet into bread in order to reduce imports of wheat and wheat flour (Senegal, 1977) and the Ivory Coast has attempted to reduce rice imports by subsidizing local rice producers. Because of growing food imports, the study of food consumption is now recognized to be of strategic importance.

Theoretical Issues

Consumption analysis is perhaps the most underdeveloped component of development economics, partly because most Western development economists over the past 20-25 years have assumed that supply factors occupy the central role in explaining patterns of economic growth. To the extent consumption was considered, it was treated as a drain on savings and therefore a constraint on capital formation. But consumption linkages are now recognized to have an important impact on sectoral growth and employment generation as Hirschman (1977), R. P. King and Byerlee (1977), and Bell and Hazell (1980) have shown. During the past decade, researchers have turned their attention to the relationships between income and the factor intensity of consumption patterns and the relative demand for locally-produced versus imported products. Soligo (1973) hypothesized that low-income households consume goods and services requiring

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[1/] For an analysis of urban consumer preference for rice in Senegal, see Ross (1980). The reasons why bread consumption is increasing are outlined in Kilby (1965) and Freeman (1980).

more labor and less capital and foreign exchange than do higher-income households. King and Byerlee (1977) hypothesized that low-income rural households have higher relative demand for labor-intensive, rural, and home-produced products than do urban or higher-income rural households. These hypotheses imply that more equitable income distribution may stimulate increased employment opportunities in rural areas via consumption linkages.

Planners concerned with food policy analysis need estimates of the sensitivity of demand to incomes and prices. It has generally been assumed that Engel's Law (that the income elasticity of demand for food is below one and falls as incomes increase) applies even in the low-income countries, including Africa. Moreover, the income elasticity of demand for staple foods which provide the bulk of calories is usually hypothesized to be low and to fall as incomes increase while those for meats, milk, imported foodstuffs, and nonfood items are hypothesized to exceed one at all income levels. The influence of price has received little attention in consumption studies in Africa, largely because there have been few cases in which it was possible to estimate price elasticities. Consistent with consumer theory, it has commonly been hypothesized that the demand for staples such as millet and sorghum is price inelastic while that for foods such as rice, wheat, meats, beverages, services, and nonfood items is price elastic. Researchers working in Africa have hypothesized that several factors other than income and price have an important effect on consumption patterns, including the size and composition of households, location with respect to a large town or city, ethnic group, education, and the extent to which production is oriented toward the market.

Methodological Issues

There is a paucity of data on consumption patterns and linkages in Africa. In large part, this is attributable to difficulties in generating reliable data. In a widely cited article, Farnsworth (1961) argued that consumption estimates based on highly aggregated food balance sheets were significantly distorted because (1) reliable data came primarily from exports and government-controlled commercial transactions, (2) agricultural production was invariably underestimated, and (3) regional differences are so great that estimates of national consumption patterns can seriously misrepresent the consumption patterns of most of the population.

Most estimates of consumption patterns in Africa have been based on cross-sectional expenditure surveys which have often taken into account only cash transactions. As a result, few studies have been able to identify seasonal variations in consumption patterns or the change in consumption patterns as production for the market increases. For evaluations of the advantages and disadvantages of cross-sectional surveys for

consumption analysis in Africa, see Howe (1966), Massell (1969), and Simmons (1976c). Methodological issues in collecting consumption data are discussed by Winter (1975) and Sarah Lynch (1980). Issues to consider in the selection of functional forms of demand equations and estimating techniques are discussed in Massell (1969); King and Byerlee (1978); V. E. Smith et al. (1980); Smith, Strauss, and Schmidt (1981); and Strauss (1981).

Empirical Findings

Consumer expenditure studies were conducted in a number of African cities in the 1960s. Although these urban surveys were often motivated by the need for data to construct consumer price indices for government/trade union wage negotiations, they provided some insights into the determinants of expenditure patterns and they generated expenditure elasticities[1/] for groups of goods and services. In a review of several urban consumption studies, Poleman (1961) found that expenditures on food were around 60 percent of all expenditures. Several studies have indicated though that the percentage of income spent on food in urban areas may often be less than 60 percent (Howe, 1968; Ostby and Gulilat, 1969).

In an expenditure study in Nairobi, Massell and Heyer (1969) found that the income elasticity of demand for all food was low (.48) but that meals away from home and rice had much higher income elasticities of demand and that the income elasticity of demand for most nonfood items exceeded unity. Massell and Heyer further showed that the house-size elasticity for food was low (.36) because, they hypothesized, households tended to substitute cheaper food for more expensive food as the number of consumers increased. Several urban budget studies indicated that consumers adjust their pattern of consumption in response to occupation, employment status, age of head of household, education, and tribal affiliation but the results were not consistent across surveys (Howe, 1966, 1968; Poleman, 1961).

During the 1960s, pioneering rural consumption surveys were carried out in a few countries such as Rwanda and Burundi (Leurquin, 1960); Ghana (Dutta-Roy and Mabey, 1968; Dutta-Roy, 1969); and Uganda (Massell and Parnes, 1969). Information on rural consumption patterns was also presented in two USDA-sponsored studies in Ghana (Ord et al., 1964) and Nigeria (I. G. Stewart, Ogley, and Wright, 1962). Most of the 1960s' rural consumption surveys found that the proportion of expenditures (cash and imputed) for food in rural areas was higher than in urban areas. But, not unexpectedly, cash expenditures on food were often quite low since most households produced the majority of their food needs. Of cash expenditures, clothing was usually the largest item of expenditure,

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[1/] Expenditure elasticities were generally computed because data were not available for the computation of income elasticities of consumption items.

followed by taxes, fuel and lights, beer, and schooling. Agricultural equipment and supplies was rarely found to be a major expenditure item. In general, combined expenditures on food, clothing, and shelter accounted for around 80 percent of expenditures for most rural households. Gifts and ceremonial expenditures were a surprisingly important expenditure, accounting for as much as 5 to 10 percent of annual expenditures.

In terms of the relationship between expenditure patterns and income, it has been consistently found that the share of expenditures for staple foods declines with increasing incomes and that expenditure elasticities for meat and other livestock products are the highest of all food items. Higher-income rural households also tend to spend a greater proportion of their incomes on housing, household supplies, hired labor, and consumption of beer and tobacco than do lower-income households. However, a notable finding of several household budget surveys in the 1960s was that most increases in expenditures stem from quality changes in bundles consumed rather than from a different pattern of expenditure. Because rural consumers tend to substitute foods such as meat, milk, rice, and purchased meals for coarse grains as their incomes increase, the proportion of expenditure going to food does not decrease as fast as otherwise might be the case. This has led some researchers (e.g., Ord et al., 1964) to question whether Engel's Law holds over the range of income found in rural areas.

Consumption analysis received sporadic attention in the 1970s. Humphrey and Oxley (1976) collected data on nearly 7,500 urban and rural households in Malawi and found little similarity between expenditures of rural and urban households, whether in terms of absolute levels of expenditures or their rankings. Expenditure elasticities for rural households were estimated to be .706 for food, .968 for total durable goods, and 1.546 for household construction. This expenditure elasticity for food is lower than those estimated by Leurquin for Rwanda and Burundi (.9) and King and Byerlee for Sierra Leone (.93). On the basis of interviews with 120 families in three villages in northern Nigeria, Emmy Simmons found that the overall elasticity for food was only around .4 but this was largely attributable to the extremely low elasticity for sorghum (.14), the staple food in the area (1976c).

R. P. King and Byerlee's (1978) national consumption survey in Sierra Leone was the first study in sub-Saharan Africa, to our knowledge, to have estimated the factor intensity of rural consumption patterns by income group. King and Byerlee found that at all income levels the greatest proportion of expenditures was on rice, the staple food which was produced by 97 percent of the farmers in their national sample in Sierra Leone. They also found that the marginal propensity to consume increased by income level with higher-income households consuming more livestock products, beverages, tobacco, transport, services, and ceremonial activities. The marginal propensity to consume at higher-income

levels was the highest for expenditures on services and ceremonial activities (see also Byerlee et al., 1982). King and Byerlee concluded that there was weak support for Soligo's hypothesis that low-income households consume goods and services requiring less capital and foreign exchange and more labor than higher-income households.[1/] King and Byerlee also compared consumption patterns between rural and urban consumers and found that rural households consumed more labor-intensive goods, that rural-urban consumption linkages were poorly developed, and that the urban centers produced consumer goods purchased almost exclusively by urban consumers.

In follow-up analyses of the Sierra Leone survey data, Victor Smith et al. (1979) disaggregated estimates of food consumption and related consumption per consumer equivalent to income, the number of consumer equivalents in a household, the dependency ratio, ecological zone, market orientation, and the proportion of labor devoted to rice. Smith et al. (1980) used tabular analysis to evaluate the effect of nonprice factors on consumption. They found that region, ethnic group, household composition, and orientation toward market production all affect consumption patterns but that the effects differ among foods and among classes (by income) of households. Smith, Strauss, and Schmidt (1981) presented quantity and share equations and derived expenditure elasticities for 14 major foods plus 6 groups of foodstuffs. Strauss (1981) made a major contribution in estimating elasticities by using a household-firm model with a quadratic expenditure system. The series of studies by V. E. Smith and his colleagues have made it clear that (1) it is necessary to move toward more disaggregated analysis of consumption patterns since general categories such as food or even cereal grains may hide more than they reveal about how consumption patterns are likely to change over time, and (2) nonprice factors, particularly the pattern of household production, have an important influence on consumption patterns and it is long overdue for researchers working in Africa to begin analyzing the relationships between the production and consumption decisions of rural households.

Synthesis

Consumption analysis has received too little attention in Africa. Consumption linkages are important in the development process and have taken on additional importance in light of rapidly rising food imports. Empirical research has shown that most of the standard hypotheses of consumer theory can generally be expected to hold for rural households in Africa, provided it is recognized that nearly all rural households are low-income households and therefore food expenditures will dominate the consumption

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[1/] King and Byerlee hypothesized that the relatively uniform income distribution in rural Sierra Leone may explain the differences in their findings and the results of Soligo's test of the factor intensity hypothesis in Pakistan.

bundles of most rural households. The small body of consumption studies conducted over the last decade has made it clear that there is a wide range of nonprice factors which affect consumption patterns in Africa. Moreover, there is substantial evidence that expenditure analysis should be carried out on disaggregated categories of food and nonfood items and should take into consideration the relationships between the production and consumption decisions of households. Because consumption and production decisions are strongly related, we feel that expenditure analysis should be an integral component of future farm surveys in Africa. For a bibliography of food consumption surveys, see FAO (1981c).

Nutrition

Over the past 50 years, nutrition research in Africa has been dominated by medical workers, nutritionists, geographers, and anthropologists.[1/] Most nutrition researchers have not collected adequate data on household incomes, relative prices, and home consumption to analyze the impact of economic policies on nutrition. During the 1960s, a few economists such as Joy (1967) started raising questions about nutrition in Africa but it was not until the 1970s that serious research on the economics of nutrition got underway. For one of the few economic studies of nutrition at the village level, see Emmy Simmons' (1976a) analysis of caloric and protein intake in three villages in northern Nigeria. Simmons (1976a) found that the average diet provided 2,264 calories and 55 to 65 grams of protein. Sorghum and millet accounted for 70 percent of the caloric intake and most of the supply of protein. Simmons showed that there was a significant positive relationship between nutrient intake, estimates of amount of grain in storage, and the family labor hours spent on farm work. One of the first comprehensive studies of the economics of nutrition on a national scale was V. E. Smith's (1975) study in Nigeria. More recently, V. E. Smith and colleagues at Michigan State University have examined the effect of price and income changes on nutritional levels in Sierra Leone drawing on survey data collected by Dunstan Spencer in 1974/75 (V. E. Smith et al., 1979, 1980).

Three major issues have dominated research on nutrition in Africa in the 1960s and 1970s: (1) seasonal hunger, (2) impact of cash crop expansion on nutritional status, and (3) strategies for alleviating malnutrition.

[1/] Research on nutrition can be traced to Audrey Richards' (1932, 1939) studies of the Bemba in northern Rhodesia (now Zambia). An outstanding overview of nutrition and health in East Africa is Kraut and Cremer's (1969) study of Kenya and Tanzania which drew on anthropometric measurements, food consumption survey data, demographic information, and clinical assessments of nutrition. An overview of nutrition problems and guidelines for nutrition workers is Latham's (1980) Human Nutrition in Tropical Africa. For a policy overview on nutrition in the Third World, see Alan Berg (1981). For a basic reference on nutritional surveillance techniques, see WHO (1976).

Seasonal Hunger

Nutritionists have long pointed out that nutrient availability varies by season. The concept of seasonal hunger (soudure) has been examined by colonial administrators, anthropologists, and geographers. Seasonal hunger refers to a decline in food intake for one to three months before harvest because food stocks have been exhausted and rural households lack the financial resources to purchase adequate food in the market. Colonial administrators, for example, directly and indirectly forced farmers to plant crops such as cassava in order to create a potential food reserve because cassava could remain in the ground for one to three years. Unfortunately, there are few hard data on food consumption, body weights, and labor productivity during the hungry period. The literature on seasonality and food availability has been drawn together by Annegers (1973) for West Africa. In their survey of seasonal hunger in the Third World, Longhurst and Payne (1979) report that there is no consensus on how to deal with seasonal hunger because of the scattered nature of the empirical studies and the complex methodological problems.

Haswell's (1953) study in the Gambia in West Africa revealed that body weights of rural people declined during the hungry season. In her re-study (1975), she presented data to suggest that rural people in the Gambia were more vulnerable during the hungry season than 20 years earlier because a larger percentage of total family calories is purchased today. Hunter (1967) studied seasonal hunger among the Nangodi people in northeast Ghana and found that an average member of the adult community lost 6.4 pounds of body weight during the hungry season preceding harvest. Nearly a quarter of the adults lost more than 10 percent of their body weight and even in the period following harvest 6 percent of the active adult population remained underweight.

The impact of drought on nutrition has been explored by a number of researchers and research teams in numerous African countries. A nutrition survey team (Kloth et al., 1976) used anthropometric measurements to ascertain the incidence of malnutrition in 1974 in the Sahelian region of West Africa.

Impact of Cash Crop Expansion on Nutritional Status

A major theme of research on nutrition has been the impact of the expansion of nonfood cash crops on the nutritional status of rural families and plantation workers. There are two opposing views on this issue. On the one hand, it is argued that if nonfood cash crop expansion results in higher net returns to farmers, then the rural households can maintain their level of food consumption and nutritional status by purchasing more food or other items with their incremental income. On the other hand, it is argued that an expansion of cash crops might substitute for land producing food crops which will lead to a

reduction in home food production and in the nutritional status of farm families. Unfortunately, the available research rarely quantifies the impact of expanded cash crop production on acreage planted, output, and food prices in the area. Moreover, the definition of cash and food crops is fuzzy. Although crops such as coffee and cotton are grown primarily for the market as cash crops, some food crops such as maize and groundnuts can be consumed or sold as a cash crop. In this section, we shall examine the impact of nonfood cash crops such as coffee, cocoa, and cotton on the nutritional status of the households producing these commodities.

Perisse (1962) examined the cash crop hypothesis in three ecological zones in Togo and found some evidence to suggest that the expansion of cocoa and coffee reduced food production. But Perisse offered no quantitative data on shifts in acreage output or changes in the price of food crops. Collis, Dema, and Omololu (1962) assessed the impact of expanded cocoa production on the nutrition of rural households in a survey in western Nigeria and found that people living in cocoa-producing villages were in worse condition from a nutrition point of view than villages not producing cocoa. Collis et al. concluded that nutrition education programs were needed. Idusogie (1969) examined cash cropping in Nigeria and came up with inconclusive results.

The cash crop hypothesis was recently tested by the Ministry of Health in Kenya as part of a broader study of child nutrition in rural areas. A major indicator used to evaluate the nutritional status of children was "height for age" which is less subject to short-term fluctuations than a "weight for height" standard. The study revealed that in farming systems emphasizing one or more of five cash crops--coffee, tea, cotton, pyrethrum, and sugar cane--there was little evidence with the exception of sugar cane to support fears that cash crop cultivation is detrimental to nutritional well-being (Kenya, 1979, pp. II. 3.9). In the case of sugar, apparently children consumed so many empty sugarcane calories that they were unable to meet their other nutritional needs. Also in Kenya, Keller, Muskat, and Valder (1969) used regression analysis to test the relationship between a series of economic variables and two dependent variables: anthropometric measurements and the adequacy of diet. Keller et al. found that calorie adequacy was positively correlated with total cash income, income from the sale of agricultural products, land size, and expenditure for food and clothing.

Lev (1981) drew on farm management and food consumption data collected by Zalla (1981) and examined the impact of coffee production on food consumption among the Meru people in northern Tanzania. Lev found that the simple food/cash crop dichotomy did not hold because the Meru have developed a farming system where coffee is always intercropped with bananas. Lev found in his regression analysis that the coffee/banana intercropping had a positive influence on the nutrition adequacy ratios. Lev also reported

that formal education had little effect on nutrition, probably because nutrition was not covered to any great depth in the schools.

The results of the above studies provide little support for the hypothesized inverse relationship between export crop expansion and malnutrition. But in several cases, the hypothesis was not rejected; it merely could not be shown to be statistically significant. Also, there have been few attempts to evaluate changes in nutrition over time in a given community following the introduction of cash crops. Although the cash crop hypothesis now seems to be of doubtful validity, it remains to be rigorously tested.

Strategies for Alleviating Malnutrition

Historically, policies designed to alleviate malnutrition have focused on (1) increasing the protein content of local diets, assuming that protein was the most important cause of malnutrition, and (2) establishing nutrition clinics. Many child feeding programs focused on children under age five since it was common for children to suffer from both kwashiokor, a lack of protein, and marasmus, a lack of protein and calories. Limited success and high costs of nutrition clinics have made it apparent that a national malnutrition strategy based on widespread use of clinics is not feasible in Africa nor other Third World regions (Pinstrup-Andersen, 1981).

The 1970s were a turning point in thinking about the proximate causes of and strategies to deal with malnutrition. The hoped for reduction in malnutrition through increased per capita incomes has not been achieved in the Third World in the past 30 years. Research in the 1970s has shown the major cause of malnutrition is generally a lack of calories (energy) rather than a lack of protein except for people in ecological zones where the main staple (cassava, yams, bananas) is low in protein (Sukhatme, 1970; Reutlinger and Selowsky, 1976). A consensus has emerged that malnutrition is unlikely to be solved in the normal course of social and economic development in market-oriented economies and that the most effective way to reduce energy and protein deficiencies is to incorporate nutritional goals and programs into development projects and policies (Pinstrup-Andersen, 1981).

The new consensus that malnutrition problems can only be solved through the incorporation of both poverty and nutritional goals in development policies and projects has stimulated the preparation of food and nutrition strategy statements and research on the impact of macro policies (e.g., agricultural prices) on nutrition. A standard reference is FAO/WHO (1976), Food and Nutrition Strategies in National Development. One of the first attempts to produce a food sector strategy statement in Africa was made at a workshop in Kenya (Westley, Johnston, and David, 1975) followed by Olayide and Olayemi (1978) in Nigeria. Food Sector Strategy statements have been prepared for a number of countries in Africa, including Senegal (1977) and the Sudan (1977). For a review of problems in developing operational food strategy plans, see Pinstrup-Andersen (1981).

VIII. MIGRATION, EMPLOYMENT, AND EQUITY ISSUES

Starting in the mid-1960s, policy makers, donors, and scholars began to acknowledge that equity objectives were frequently not being achieved in development programs even in countries achieving relatively high growth rates (Clower et al., 1966; Eicher et al., 1970). The concern over equity issues has stimulated a large body of research on the following topics: income distribution, population growth, national and international migration, women in development, and rural employment problems. This part reviews the empirical evidence on these topics.

Income Distribution and Inequality

When Simon Kuznets (1955) published his seminal paper on income distribution some 25 years ago, he apportioned the subject into "perhaps 5 percent empirical information and 95 percent speculation." On the basis of our literature review, a figure of 99 percent speculation is probably closer to the mark in sub-Saharan Africa. For example, Jain (1975) reports data on the size distribution of income in 10 countries in Africa with the earliest data reported for 1958. Phillips (1975) reviewed data sources for Ghana, Kenya, Tanzania, and Nigeria and reported that data are rarely available for more than 15 years. Currently data on income distribution are available for only about one-third of the countries in sub-Saharan Africa. Moreover, most of these data are based on cross-sectional surveys in urban areas. For a recent collection of studies on income distribution in Africa, see Justinian Rweyemamu (1980).

Historical Perspective

Little is known about the distribution of income in a historical perspective. We have pointed out that colonial policies exacerbated inequality in some countries through numerous decisions to assist plantation owners and European settlers in producing cash crops and grade (improved) cattle. Although the sources of many forms of inequality can be traced to colonial policies and settlement patterns, inequality was obviously present in the precolonial era.[1/] For an analysis of the origins of inequality in Zambia, see R. E. Baldwin (1966); in northern Nigeria, Hill (1968, 1972); in Kenya, Heyer (1981); and in Central and Southern Africa, the collection by Palmer and Parsons, eds. (1977).

Two important books by economists document how contemporary problems of inequality are often linked to colonial policies. The first is R. E. Baldwin's (1966) analysis of Zambian development, a dual economy dominated by copper for export, and by

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[1/] For example, Derman and Derman (1973) present a valuable ethnographic study of the evolution of an inegalitarian serf village in Guinea under colonial, postindependence, and socialist conditions.

Europeans who provided the skills for the copper industry and commercial farms which produced maize for African mine workers. The second is a Northwestern University study by Clower et al. (1966), Growth Without Development: An Economic Survey of Liberia which was 5-10 years ahead of the time in questioning the likely benefits of a high rate of growth of GNP. Clower and his associates showed that Liberia's impressive growth rates of 7-9 percent in the 1960s were not benefiting the masses because the underlying social and economic structure was channeling the benefits to urban people, to bureaucrats, and to the foreign firms which controlled mining, timber, and rubber plantations. The Liberian government attempted to suppress the draft manuscript but it was eventually published. The rice riots in 1979 and the coup d'etat of 1980 dramatize the underlying inequality in Liberia and point to the political cost of growth without development.

Methodological Issues

Kuznets (1976) and Knight (1976) have identified some of the problems in carrying out research on income distribution. The first issue is the need to clarify the objective of the research. Is the major concern one of measuring absolute or relative poverty? Although most research has relied on cross-sectional data to measure relative inequality, we know that cross-sectional data are not very useful in understanding the causes of inequality. The ILO report on Kenya (1972) and Hazlewood (1978) urge researchers to shift their attention from relative inequality to absolute poverty, including attention to changes in absolute income, malnutrition, and employment.

The second issue is one of definition of the recipient unit to be studied. Although there is widespread agreement that the household should be the recipient unit, there is great diversity in size and complexity of African households. Kuznets (1976) recommends taking account of different sizes of households by using income per person or per consumer unit as the basis of comparisons. The next and more difficult step is to take the life cycle of households into consideration in comparisons of income distribution. This requires demographic data to be generated, allowing the lifetime income of a cohort of households to be studied over time. The third problem is measurement of wages and income in subsistence households. Should firewood be included in national accounts and estimates of rural income? How should unpaid family labor and subsistence food production be valued? This problem has plagued national account surveys in Kenya. As of 1978, it was impossible to use Kenya's system of national accounts to draw inferences about changes in functional distribution of income because wages of the self-employed and the value of unpaid family labor were not included in the computation of national accounts. For a debate on national accounts and income distribution in Kenya, see Hodd

(1976); a critical note by House and Killick (1978); Hodd's reply (1978); and for the resolution of the debate, see Hodd, House, and Killick (1978). The fourth problem is dealing with seasonality of activities such as fishing, farming, and livestock grazing. How can rural incomes of nomadic and seminomadic herders be estimated in Botswana and Mauritania when herders are constantly on the move? In the Gambia, a large percentage of the rural labor force is composed of seasonal migrants from neighboring countries. Data on remittances are essential for measuring the social welfare effects of international migration. These problems help explain why much of the research on rural income distribution in Africa should be treated with caution.

Empirical Evidence

Jain's (1975) summary of research on the size distribution of income covers 10 countries in sub-Saharan Africa with the earliest data from Chad in 1958 but data on rural income are available in only three of the ten countries. The data summarized by Jain and studies of income distribution in Botswana (Botswana, 1976), Tanzania (Van Ginneken, 1976), Malawi and Rhodesia (R. A. Jones and Robinson, 1976), Sierra Leone (Byerlee et al., 1977), and Nigeria (Matlon, 1979) show that incomes are generally more equally distributed in sub-Saharan Africa-- especially West Africa--than in Latin America, and that rural incomes in Africa are more equally distributed than urban incomes. But these data must be treated with caution because the Gini coefficients for almost all of the countries were computed by piecing together numerous household budget surveys (mainly urban), farm management studies, and data from national accounts. For example, in Zambia, R. E. Baldwin (1966) computed a Gini coefficient of .48 for Zambia based on his 1959 survey. Subsequent studies by Van der Hoeven (1977) suggest that by pooling various ad hoc surveys one can conclude that it is "almost certain that incomes in Zambia over the 1960-70 period have been more unevenly distributed." C. M. Elliott (1980) examines the unresolved conflicts in growth and equity policies for rural development in Zambia.

Botswana was until recently one of the poorest countries in Africa. But with the discovery and exploitation of vast mineral resources, notably diamonds, the rate of growth of the GNP has been impressive--13.2 percent over the 1970-79 period. Livestock dominate the rural economy and it is difficult to generate reliable national accounts and income distribution data from nomadic and seminomadic herders. In 1973, Robert McNamara, then President of the World Bank, gave a speech in Nairobi and stressed the need to give more attention to research on rural development and income distribution. As a direct follow-up to McNamara's speech, the government of Botswana carried out a Rural Income Distribution Survey (RIDS) in 1974/75 (Botswana, 1976). Botswana now has the most comprehensive data set on income distribution in Africa. The RIDS covered 1,765

households, including 1,115 rural households who were interviewed monthly, supplemented by estimates from the Central Statistics Office (CSO) for 593 rural households and 62 nomadic households. The results of the RIDS revealed that the lowest 40 percent of the rural households received only 12 percent of the income; the Gini coefficient of 0.52 indicated a high degree of inequality which is believed to be a function of the unequal holdings of livestock. Szal (1979) has advanced a number of proposals to reduce inequality within rural areas, notably the reduction of local and income taxes, school fees, etc.

A comparative study of rural income distribution in Sierra Leone and Nigeria was carried out in the mid-1970s. Rural incomes were defined as the return to household, land, labor, and management in all farm and nonfarm occupations. In both countries, rural households were interviewed twice a week over 52 weeks. In Sierra Leone, the Gini coefficients were found to be 0.34 at the village level, 0.38 at the resource region level, and 0.39 for the nation (Matlon et al., 1979). Norman, Pryor, and Gibbs (1979) report Gini coefficients for rural areas of northern Nigeria in the range of .30 to .40. Matlon's (1979) study of income distribution in three villages in northern Nigeria generated a Gini coefficient of 0.28 at the village level, indicating a high degree of equality. When income from Moslem women engaged in food processing and trading activities were incorporated into the estimates of income of the sampled rural households, the Gini coefficient was 0.24. The high degree of rural equality in Sierra Leone and Nigeria appears to be a function of a relatively egalitarian land tenure system, and the absence of technical change. Nevertheless, the research reveals that there is a serious degree of absolute poverty among the poorest 30 percent of the rural population in both Sierra Leone and in Nigeria (Matlon et al., 1979). Large-scale rural surveys which produce gini coefficients have been appropriately criticized by scholars such as Palmer-Jones and Polly Hill. For example, in Polly Hill's (1968) case study in northern Nigeria, "The Amorphous Peasantry," she takes economists to task for assuming that "poverty is roughly uniform as between farmers" and she questions whether survey research is an appropriate tool for understanding rural inequality. We agree that although cross-sectional data from rural surveys can provide snapshots of income distribution, they cannot get at the roots of inequality.

Income distribution has been an important topic for researchers and policy makers in Kenya. The historical origins of rural inequality are examined by Heyer (1981) and C. Barnes (1979). The ILO Employment Mission (1972) to Kenya devoted major attention to income distribution problems. The Government of Kenya's response (Kenya, 1973) to the ILO report has been criticized by Ng'ethe (1980) because it accepts the status quo and does not come to grips with the cause of rural inequality--inability of the poor to gain access to land, credit, and government services.

Research Agenda

Research on rural income distribution and inequality is in its infancy; much remains to be done, and undoubtedly this is a high priority research topic for the 1980s. The computations of Gini coefficients is only a small portion of the research needed to understand the causes of inequality. The starting point for improved research is to face up to the methodological issues discussed above. There is a need for research on asset ownership and how ownership and control of assets influence income distribution. Since the control of resources--land and capital--is often a function of historical forces, it behooves economists to pursue research on asset ownership in historical perspective. Unfortunately, Western-trained agricultural economists are noted for their lack of interest in economic history. There is also a need to examine the impact of government policy on asset ownership and the linkages between political power and accumulation of wealth and the influence of wealth accumulation on political power. Finally, there is a need to analyze how various classes and groups in society--women, landless, tenants, etc.--are affected by technical change, by migration, and by various government policies such as subsidized credit.

Berry (1976), Post (1972), Van Hekken and Van Velzen (1972), and Sklar (1979) offer perceptive comments on how to use class analysis as an organizing theme for research on inequalilty. Hazlewood (1978) stresses the need to keep research focused on both growth and income distribution rather than jumping on the income distribution "band wagon" and formulating policy prescriptions on the basis of results from narrowly conceived studies.

Studies on income distribution and inequality include:

Africa General: Jain (1975); W. A. Lewis (1978); Rweyemamu (1980).

West Africa: Berry (1980); Post (1972); Matlon et al. (1981).

Botswana: Botswana (1976); Szal (1979).

Ghana: Hill (1963, 1970); Phillips (1975); Winch (1976); Ewusi (1977).

Ivory Coast: Lee (1980).

Kenya: ILO (1972); Phillips (1975); Hunt (1975a); Holtham and Hazlewood (1976); Heyer (1981); Heyer and Waweru (1976); Hodd (1976); House and Killick (1978); Hodd (1978); Hodd, House, and Killick (1978); Hazlewood (1978); Barnes (1980); House and Killick (1980); Ng'ethe (1980).

Liberia: Clower et al. (1966).

Malawi: Ghai and Radwan (1980).

Niger: Raynaut (1976).

Nigeria: Hill (1968); Essang (1972); Aboyade (1973); Phillips (1975); Matlon (1979); Bienen and Diejomaoh (1981).

Sierra Leone: Byerlee et al. (1977).

Tanzania: Van Hekken and Van Velzen (1972); Phillips (1975); Van Ginneken (1976).

Zambia: R. E. Baldwin (1966); Maimbo and Fry (1971); Van der Hoeven (1977); Blitzer (1979); Kinsey (1978); C. M. Elliott (1980); Turok (1979).

Zimbabwe: R. A. Jones and R. J. Robinson (1976).

Population

Demographic research was started in most countries in sub-Saharan Africa only during the past 20-30 years. Since few countries maintain an accurate register of births and deaths, the quality of demographic data is extremely uneven. Among the most important demographic characteristics of sub-Saharan Africa are the following:

1. The population is young with nearly half of the people under age 15 compared to only about one-quarter in Europe and North America.
2. Fertility levels are high and almost unchanged since 1960. The 1980 crude birth rate was 48 per thousand as compared with 49 in 1960.
3. Fertility levels are extremely heterogeneous within and between countries. In a recent study, Lesthaeghe, Ohadike, and Kocher (1981) report that the fertility of Africa represents a "mosaic of strongly contrasting levels of fertility." This again points out the fallacy of discussing averages--such as crude birth rates--in a sub-continent of such complexity and diversity.
4. Although mortality has been declining in recent decades, it is still very high by international standards. The overall crude death rate is around 18 per thousand.
5. The average expectation of life at birth is below 50 years.

Because of high fertility but declining mortality rates, Africa is the only region in the world where it is quite likely that the rate of growth of population will not slow down over the 1980-1990 period.[1/] The U.N. projects that sub-Saharan Africa will need to support more than twice as many people by the year 2000 as in 1970.[2/] It is clear that the pattern and pace of population growth will be an important issue facing African policy makers during the remainder of the century (Cantrelle, 1974; Caldwell et al., 1975; Easterlin, 1980). First, as Byerlee and Eicher (1974) point out, any discussion of the employment problem must be viewed in light of the high population growth rate. Second, long-term solutions to "Africa's food crisis" must take into account population growth

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[1/] For example, Kenya's 1980 rate of population growth of 3.4 percent means that population will double in 17 to 20 years and that the three-way race for land--food production, tourism, and livestock--will remain an explosive political issue over the next 20 years (Shah and Willekens, 1978). Although the World Bank estimates that Kenya's 1980 population growth rate was 3.4 percent, several reliable but unofficial estimates put the figure at close to 4.0 percent.

[2/] These UN projections are based on the assumption that the current annual growth rate of around 2.7 percent in sub-Saharan Africa will increase in the 1980s and early 1990s before beginning to decline. The rate of population growth is expected to increase in the short-term largely because of the young age structure of population, high fertility levels, and a continued reduction in the death rate.

since the rate of population growth tends to dominate projections for future food requirements (FAO, 1976c). Third, Kocher (1979) has shown that governments have a harder time providing social services when the population is growing rapidly. Fourth, many demographic experts agree that there are areas in sub-Saharan Africa which are now being affected by more or less serious problems of population pressure (Cantrelle; Caldwell et al.). Finally, several village studies have shown that greater spacing of children may increase the chance of survival during times of stress. Faulkingham and Thorbahn (1975), for example, found that malnutrition was rarely a problem among the men of Tudu, a village in Niger, but it was common among women and children. When Faulkingham (1977) conducted follow-up research in the same village, he found that 25 percent of all children age one to five died during the drought of the early 1970s when food supplies were short.[1/]

Although many scholars, donor agencies, and African policy makers agree that falling rates of per capita food production is one of the dominant issues facing African governments in the 1980s, few policy makers feel that there is a population problem. On the contrary, most African governments continued to restrict access to modern birth control devices until the early 1970s. Some countries such as Mauritania even have a pro-natal policy because they feel that their country is underpopulated. Moreover, numerous African scholars, including the late Okediji (1972) and Amin and Okediji (1974), comment that concern with population growth and promotion of family planning is Western-inspired and another "false start" for Africa.

During the 1970s, there was a shift in public policy on population in many African countries. In 1973, only nine countries supported family planning (primarily for reasons of health and as a human right) but by 1978, twenty countries had adopted this policy (World Bank, 1981b, p. 112). Nevertheless, assessments of family planning programs have consistently indicated that Africans desire large families and that their interest in contraception primarily exists for the purpose of child spacing and premarital contraception. It is fairly clear that family planning programs were introduced and promoted in sub-Saharan Africa in the 1960s and 1970s far ahead of the knowledge base about the determinants of fertility among different ethnic and religious groups. For example, family planning is currently a delicate political issue in a country like Senegal where 95 percent of the people are Moslem.

[1/] Contrary to reports published in the Western press, there is little evidence that there were comparable death rates across all age strata of the rural population. In a survey of the Sahelian drought, Caldwell (1975) found that the actual number of people who died during the six-year drought was surprisingly low.

In light of overwhelming evidence that there is not a demand for birth control and smaller families in Africa, several researchers have turned to the question of what social and economic conditions affect the pace and pattern of the demographic transition to lower fertility. In an important restatement of demographic transition theory, John Caldwell (1976) hypothesizes that high fertility is determined primarily by the direction of intergenerational wealth flows. Other researchers contend that social norms inhibit the transition to low fertility and that a reduction in the birth rate will only be possible after the individualization of choice which will occur through education, urbanization, and increased participation of women in the urban labor force (Faulkingham, 1977).

James Kocher (1979) has stressed the importance of understanding the relationship between socioeconomic development and fertility before crashing ahead with family planning programs. On the basis of interviews with the adult members of 1,500 rural households in Tanzania, Kocher concluded that the prospects for reducing fertility through family planning programs were crucially linked to Tanzania's stage of socioeconomic development. Kocher contends that in countries where 80-90 percent of the population are in the rural sector it would be unwise to promote family planning until the educational level of women is increased and problems of health and disease have been tackled.

The implications of the continuation of high fertility rates and the slow reduction in mortality rates in the 1980s and 1990s are well-known. Various scenarios suggest, for example, that Nigeria's 80 million population will reach 341 million if the current average fertility rate of 6.6 live births per woman does not decline. But the knowledge basis on the determinants of fertility is sparse. There is a large research agenda on food/population linkages; population/employment issues; population and migration; and population and nutrition and health. In our judgment, there is a need to step up demographic training in African universities. Until more African demographers are trained and debates over food, population, employment, and migration become internalized within African governments and universities, there will be many "false starts" in population interventions in the 1980s and 1990s.

Migration

The migration of rural people for work in plantations, mines, and factories has been a major catalyst for social change in Africa. Common themes in African history include long distance migration to mines in Southern Africa, to plantations in West Africa, and the role of 'strangers' in African societies. The diversity of migration streams is depicted in Shack and Skinner, eds., Strangers in African Societies (1979) which includes essays on "The Nigerian Yoruba in Ghana," "The Lebanese of Sierra Leone," "The Dahomeyans in Francophone Africa," and "The Expulsion of Luo Workers and Asian Bourgeoise From Uganda."

Historically, migration has been viewed favorably in the development literature because it was perceived to contribute to reducing intra-and inter-regional wage differentials, and in transferring new crops and ideas over wide regions. For example, Mabogunje (1972), the distinguished Nigerian geographer, observed that two or three million West Africans leave their homes and businesses every year in search of profitable economic opportunities across ethnic or national boundaries. Migrants have been characterized as innovators, risk takers, and entrepreneurs. Polly Hill's (1963) pioneering research revealed that migrants were the risk takers in settling land and mobilizing capital in Ghana's cocoa boom in the late 19th century. Parkin (1975) reported that rural and urban areas in Eastern and Southern Africa are influenced by a "vast criss-crossing of people, ideas, and resources." Vermeer (1979) found that farmers on the Jos plateau in Nigeria secured new crops and varieties of plants from traders from as far away as Liberia. These new crops (e.g., pepper and spices) were tested on intensive "garden plots" near the compound (main housing unit) of rural families and the more promising crops and varieties were then introduced into the farming system.

In the early 1960s, rural-to-urban migration of young school leavers was perceived by many policy makers to be excessive, contributing to the explosive rate of growth of urbanization (8-10 percent per year) and the alleged urban unemployment of 10-30 percent. Moreover, during this period, an antimigration view emerged among numerous researchers who argued that although migration was privately profitable it was draining many of the younger and better educated from the countryside. A central policy question which followed was whether rural to urban migration should and could be controlled by national governments.

Theoretical Perspectives

The analysis of migration is important in order to understand the linkages between rural-rural and rural-urban labor markets and for national policy analysis, including decisions on industrialization, regional planning, location of social services, and pricing and subsidy policies. Policy makers require information about (1) who migrates, (2) rates of migration, (3) determinants of migration, (4) remittances, (5) level of urban unemployment, (6) international migration, and (7) social costs and benefits from migration.

There are three broad and interrelated schools of thought or theoretical perspectives on migration: (a) structural-functionalist, (b) neoclassical economics, and (c) political economy. The structural-functional approach by anthropologists, sociologists, and geographers has a long history starting with Schapera (1947) and followed by Mitchell (1959), Gugler (1969), Hutton (1973), and Parkin (1975). The structural-functionalist approach examines the individual decision to migrate within a broad pattern of social

relationships and social-structural conditions, including some economic variables. A major publication in the structural-functionalist tradition is the book edited by Parkin, Town and Country in Central and East Africa (1975). The contributors present a generally positive view of migration.

Neoclassical economists treat migration as an economic phenomenon in which the migrant weighs the costs and returns from present and future employment opportunities. For example, Elkan (1959, 1980) and Berg (1961, 1965) observed that short-term circular (later called oscillating) migration supplements the income of the seasonal migrants. A turning point in migration research by neoclassical economists came with Todaro's (1969) "expected incomes" model of migration based on his research in Kenya in the mid-1960s. Todaro's seminal contribution has provided a framework for much of the econometric work on migration in the past decade. Todaro's model was designed to answer one question--why was rural to urban migration continuing in light of high open unemployment rates in urban areas? The main characteristics of the model are: migration occurs largely for economic reasons, urban wages are set by institutions (e.g., government minimum wages) above the market clearing level, and that rural workers compare expected incomes in the urban sector with agricultural wage rates and migrate if the former exceeds the latter. Expected incomes are based on migrants' perception of (a) the difference in real incomes between rural and urban job opportunities, and (b) the probability of obtaining an urban job. Todaro contended that it was futile for governments to try to solve urban unemployment problems by creating more urban jobs because more urban jobs would likely induce more rural to urban migration and paradoxically result in more rather than less urban unemployment. Todaro contended that raising the incomes and standard of living of rural people was the major policy instrument for reducing rural to urban migration. Todaro's model was extended by J. R. Harris and Todaro (1970) by explicitly specifying the "elasticity" of migration (the induced migration) response to changes in urban-rural wage differentials and urban employment probabilities. For a discussion of extensions of the Todaro model over the past ten years, see Todaro (1980).

Neoclassical models of migration play up the role of economic variables in explaining migration but these models do not shed much light on the net social loss or gain from internal or international migration. Moreover, as Fields points out, even if "economic factors are primarily responsible for migration behavior, which economic variables are included and how they are specified makes a great deal of difference in the explanatory power of the economic model" (1980, p. 392).

In the political economy approach, the historical expansion of capitalism is viewed as the main explanation of migration and it is assumed that while migration may improve the private economic return of the individual migrant, the net short-and long-term social and economic effects of migration may be negative in the source area and positive in the receiving area. Amin (1974b), for example, asserted that "Migration impoverishes the home area and proletarianizes the migrants." Plange (1979) examined migration from northern Ghana to plantations and gold mines during the 1900-40 period and concluded that migration contributed to poverty and underdevelopment of the northern region. In the ten-country region of Southern Africa, the theme of exploitation has dominated the long history of research on migration from Malawi, Botswana, Lesotho, and Swaziland to the gold mines in the Republic of South Africa starting with Schapera's (1947) classic study and continuing with Wilson's (1972) historical analysis of the wages of black workers in the gold mines. These scholars contend that migration facilitates capital accumulation in the Republic of South Africa by drawing on "labor reserves" in countries such as Lesotho, Botswana, and Malawi. These latter countries still supply up to one-fourth of their adult male labor to the mines in the Republic of South Africa on short-term (usually nine months) contracts. Census data show most migrants working in the mines enter the mines at an early age and return to their homes in rural areas once a year and generally return to live permanently with their families by late middle age.

Methodological Issues

Byerlee (1972) reviewed several hundred migration studies in Africa and reported that the bulk of research on migration over the 1950-70 period was carried out by sociologists, geographers, and demographers relying on census data and cross-sectional surveys of migrants in urban areas. Unfortunately, most of these studies did not quantify the determinants of migration and were inconclusive about the role of economic variables in the migration process. Byerlee also found that information rarely has been generated on both male and female migrants for an entire region, or country, including remittances and return migration. In addition, few migration studies have ever generated accurate data on rural incomes. As a result, many of the comparisons of rural-urban income differentials (and some of the policy conclusions by economists who advocate reducing the rural-urban income gap) must be treated with skepticism. The conceptual problems in defining and measuring income are spelled out by Knight (1972).

The starting point for research on rural to rural and rural to urban migration is to focus on the conceptualization of the migration decision-making process in rural families, viewing migration as a holistic process. Factors affecting the decision to migrate can be analyzed in terms of (a) monetary costs and returns related to incomes and employment in

the rural and urban labor markets, and (b) non-monetary costs and returns relating to risk, attitudinal characteristics, social ties, and expectations. But to generate these data requires more resources than are usually available to a single researcher studying migration.

A study making a major contribution to methodology was conducted in 1974/75 in Sierra Leone by Byerlee, Tommy, and Fatoo (1976). The major policy question in their national migration survey was: Why was rural to urban migration proceeding at a high rate when unemployment was alleged to be high (30 percent) in urban areas and the probability of obtaining an urban job was perceived to be low? Instead of using census data to compare migration streams over a 10-year period or interviewing migrants in urban areas and asking them why they left rural areas, Byerlee and his colleagues drew on information on rural incomes and labor use from a companion farm management survey of 500 rural households who were being interviewed twice a week over a 12-month period (see Spencer and Byerlee, 1976). In addition, Byerlee and his colleagues collected demographic data and work histories from 20,000 persons in rural areas; a total of 800 of the 20,000 who had migrated were "traced"[1/] and interviewed in urban areas in order to determine how they phased into the urban labor force. Detailed data were also collected on migrants returning to rural areas. The Sierra Leone study is one of the few national studies in Africa which analyzed both male and female migrants and quantified both gross and net rates of migration.

Seasonal and Rural to Urban Migration

Who Migrates?

Seasonal migration is of central importance in providing labor for farming throughout sub-Saharan Africa. Dupire's (1960) study is a classic on the role of 'strange farmers' (seasonal migrants) in the Ivory Coast. Swindell (1978) and P. David (1980) report that many of the farmers in the groundnut basin in Senegal are strange farmers who have been migrating to the basin annually from April to December since the beginning of the 19th century when groundnuts were first exported from the basin. Seasonal migration is also significant in the coffee region of Ethiopia, in cotton areas in the Sudan, and in the semi-arid areas of West Africa where migrants move from the Savannah zone (e.g., Upper Volta) to the forest zones (e.g., Ghana and Ivory Coast) during the dry season (November to April) to harvest and maintain tree crops--cocoa, oil palm, and rubber. In Ghana, Beals and Menezes (1970) estimated that 200,000 persons from the Savannah area of northern Ghana migrated annually to southern Ghana to participate in cocoa harvesting and the

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[1/] Surprisingly, Byerlee and his colleagues found it was relatively easy to "trace" and locate migrants living in rural areas.

maintenance of cocoa trees. Seasonal migration is also a way of life for nomadic and semi-nomadic herders (Dahl and Hjort, 1979). I. M. Lewis (1975) notes the movement of pastoral peoples in the Sudan to cotton picking areas. Caldwell (1975) and Baier and Lovejoy (1975) document the demographic implications of the 1968-74 Sahelian drought which forced pastoralists to move hundreds of miles in search of food, water, and grazing areas.

Invariably every migration study concludes that the typical rural-urban migrant is younger and better educated than the average rural resident. For example, Rempel's (1971) survey in Kenya and Byerlee et al. (1976) in Sierra Leone show that about one-half of all rural-urban migrants are between the ages of 15-24. The propensity to migrate for persons with primary schooling was seven times higher in Sierra Leone than for persons without education. Byerlee et al. also found that only 25 percent of the rural migrants moved for employment reasons, 40 percent move for schooling (mainly to urban secondary schools), and over 20 percent move for marriage. In Tanzania, Barnum and Sabot (1976) report that rates of migration for persons with some secondary schooling are twenty times higher than for persons without education. This diversity underscores the need to collect data on the entire rural household because many migration decisions are made by parents (e.g., migration for schooling) and these decisions would not be well understood if the migration survey were confined to interviewing migrants in urban centers.

Rates of Migration

It is difficult to compare rates of migration among countries because many censuses of population are of variable quality. In most countries, the annual population growth rate is in excess of 2.5 percent and about 0.5 to 1 percent of the rural population migrate to urban areas each year. As a result, the absolute number of people in the rural sector in many countries is growing about 1 to 2.0 percent per year, a process that will likely persist throughout this century even though the relative percentage of population in agriculture will probably decline by about 1 percent per year, e.g., from 75 percent rural to 50 percent rural population over 25 years.

Studies in Sierra Leone and Ghana are among the few which shed light on gross and net migration rates. Byerlee, Tommy, and Fatoo (1976) computed gross and net migration rates from their nation-wide survey and found that gross migration rates greatly exaggerated the magnitude of rural to urban migration in Sierra Leone because roughly two of three migrants returned to rural areas after five years. Caldwell (1969) reported a similar percentage of return migrants in his study of migration in Ghana. Hence, studies reporting gross migration rates may gloss over important differences between educated and uneducated migrants. For example, the net rate of migration for uneducated males of all ages was negative in the Sierra Leone study while the net migration of educated migrants was positive at all age levels.

Determinants of Migration

Unfortunately, most econometric studies of migration in Africa provide policy makers with limited advice on the key question--what determines migration? Most migration studies are so poorly designed and limited in scope that they cannot determine whether urban housing, public services, or "bright lights" of the cities are more important in attracting migrants than differential wage rates or employment opportunities. Since most econometric studies of urban amenities do not measure the migrant's utilization of these services, the outcome of research on this determinant is fuzzy. We do know that migrants respond to economic incentives and that friends, relatives, and distance from the sending area can be important determinants.

Studies of the Todaro hypothesis of the importance of expected income in migration decisions provide preliminary support that the job probability variable has "independent" statistical significance and adds to the overall explanatory power of the regressions (Todaro, 1980, 380-381). Although Rempel's (1971) study in Kenya found no consistent evidence that migrants responded to rural-urban income differentials, Knowles and Anker's (1981) sample of 1974 households in seven of Kenya's eight provinces provided some support for the expected income hypothesis. Likewise, studies by House and Rempel (1980) for Kenya and Barnum and Sabot (1976) for Tanzania provide some evidence that an autonomous expansion of urban jobs might induce rural-to-urban migration and add to urban unemployment.

Turning to the elasticity of migration in response to changes in urban-rural wage differentials, two major migration studies showed that the level of urban wages is decisive in explaining the decision to migrate--especially educated migrants. The elasticity of migration to wage rates was high--i.e., a 1 percent increase in urban wages increases rural-urban migration of the educated by 4 percent in Sierra Leone (Byerlee, Tommy, and Fatou, 1976) and 2 percent in Tanzania (Barnum and Sabot, 1976).

Has the Todaro model been confirmed by empirical evidence in the Third World? We conclude, on the basis of our review of the literature on migration in Africa, that Todaro's model is useful but incomplete and requires more testing. In the first test of the Todaro job probability model in India, Bannerjee and Kanbur (1981) found that the Todaro expected income differential term is significantly and positively related to rural-urban migration.[1/] There are obvious gaps which Todaro admits (1980) but his model will continue to stimulate research in the 1980s.

[1/] The findings for Indian policy are significant. Bannerjee and Kanbur's findings suggest that the effects of rural development programs will be more complex than Todaro had anticipated in that programs to reduce rural poverty will stimulate migration while those aimed at reducing rural inequality will reduce migration. Bannerjee and Kanbur find that in general much of the effects of rural development programs "will depend on the position of the 'pre-development' income distribution curve vis-a-vis the propensity to migrate curve and the intensity of the development effort" (1981, p. 23).

Remittances

While micro-research is providing some evidence on the magnitude of urban-to-rural income transfers, the empirical results are still soft on this topic. In a comprehensive survey of the literature, Rempel and Lobdell (1978, p. 205) report that remittances account for "between ten and twenty percent of migrants' urban incomes in Africa and a somewhat higher percentage in the Asian sub-continent." Caldwell (1969) provided crude estimates of urban to rural remittances in Ghana and concluded that they were approximately 10 percent of urban earnings in Accra. In Sierra Leone, Byerlee, Tommy, and Fatoo (1976) reported that urban-rural remittances account for about 5 percent of urban earnings. In urban areas of Sierra Leone, about 17 percent of the income of working migrants was used to support friends and relatives (mostly unemployed migrants trying to phase into the urban labor force).

In his introduction to a volume of studies on migration in West Africa, Samir Amin discusses remittances in West Africa and asserts that the amount of money remitted is often "so small as to be laughable and for the most part serve only to pay taxes" (1974b, p. 100). But in the same volume, Dussauze-Ingrand (1974) reports that the migration of the Sarakole people from Mauritania to France has been extensive from 1954 with an average residence of 2 to 4 years. The author estimated that remittances from France to the Sarakole were substantial--amounting to an average of $80 per capita in 1970/71 (1974a, p. 256). A research team from the University of Leiden studied outmigration from the Casamance region in southern Senegal and found that remittances accounted for 33 percent of the annual income of families of out-migrants in the village of Diotock (DeJonge et al., 1978). Zachariah and Conde (1980, p. 55) estimate that migrants in the Ivory Coast, Ghana, and Senegal remitted through official channels an average of US $81 million annually during 1967-69 and US $176 million during 1970-74. These studies are illustrations of the growing empirical evidence that is discrediting Samir Amin's commentaries on the development process in Africa.

Based on a 1971 sample of 1,140 low- and middle-income male wage earners in Nairobi, George Johnson and Whitlaw (1974) found that 60 percent of male married migrants had a wife in rural areas and remittances account for about 21 percent of the reported earnings of the men. In a 1974 national survey of rural and urban households in Kenya, Knowles and Anker (1981) found that the bottom three income groups in urban areas transferred 12 percent of their income to rural areas but that urban income transfers were less than half of all remittances, the balance being made up of transfers in kind. When the transfers in-kind were taken into account, the total urban-rural remittances are broadly consistent with the findings of Johnson and Whitlaw. Knowles

and Anker also found that rural to urban remittances were relatively unimportant and that there was a net urban to rural income flow of considerable magnitude. Heyer reports that in Kenya where "urban employment forms the basis of substantial financial flows back into rural areas, the need for small farm credit is far from obvious" (1981, pp. 113-114).

Eckert and Wykstra (1979) estimate that 60 percent of rural households in Lesotho have access to migrants' remittances from the mines in South Africa. McDowall (1976) estimates that Lesotho migrant workers in South African mines remitted approximately 60 percent of their cash earnings to their families in Lesotho. Remittances of international migrants are summarized in a recent paper by Swamy (1981).

Level of Urban Unemployment

In the early 1960s, it was widely asserted that the level of open unemployment was 20-30 percent in many African cities and that the level of unemployment was increasing. But empirical studies later revealed that the level of urban unemployment was in the range of 10-15 percent and that the important policy issue was not unemployment but massive underemployment in the urban informal sector and in rural areas. For example, in Sierra Leone, Byerlee et al. (1976) found in their national survey that the urban unemployment rate was 14.7 percent--a rate almost identical to the official government reported rate. A significant finding of the Sierra Leone study was that migration was insensitive to the level of urban unemployment since 33 percent of the 15-24 age migrants in their sample were unemployed in 1974. But the authors believed that the figure of 33 percent unemployment overstated the problem of urban unemployment because many of the unemployed were residing in higher income households (usually relatives) and were in a sense voluntarily unemployed until they found a job of their choice or revised their job expectations downward. The 33 percent average rate of unemployment of 15-24 year old migrants might fall dramatically over a 2-3 year period as the unemployed lowered their job expectations or returned to rural areas after having "out-lived" their welcome in the homes of their urban relatives. Hence, one should treat, with caution, the Byerlee et al. finding of the insensitivity of migration to the level of urban unemployment. Obviously, longitudinal data are needed on how migrants phase into and out of labor markets over time.

Do migrants have difficulty in finding urban jobs? The evidence is mixed and the research results are influenced by economic conditions, climatic variations (e.g., drought), and political and military factors. In the early 1960s, it was asserted that rural school leavers searched for jobs for one to two years in the cities. But Barnum and Sabot's (1976) nationwide study of migration in Tanzania revealed that 80 percent of the males who moved from rural to urban areas after the age of 13 found jobs within three months.

Numerous studies have shown that the informal sector (urban small-scale industry, trading, and service jobs) assimilates migrants. See Callaway's (1964) study in Nigeria, Hart's (1973) study in Ghana, and the ILO study in Kenya (1972).

International Migration

International migration (North and West Africa to France, Sahelian countries to West African coastal countries, and migration within the ten countries in Southern Africa) is now receiving major attention by researchers. Although there are many critics of international migration, Keith Griffin (1976) argues that international emigration has decidedly positive virtues, including increasing the real income of the emigrants and transmitting income and new ideas back to villages. For a negative view of migration from Senegal to France, see A. Adams (1977a). Migration from Upper Volta to coastal West African countries has been intensively studied.[1/] Various estimates show that 2 million of the 8 million Voltaics live outside Upper Volta. Much of the early seasonal migration from Upper Volta has now been converted into permanent migration of entire families. But Amin (1974b) and Dumont (1977) contend that migration from Upper Volta to Ghana and more recently to the Ivory Coast has had a disastrous impact on rural areas in Upper Volta. Unfortunately, they present few data to substantiate their assertion and few insights on what would be the welfare position in rural areas of Upper Volta if two million people had not left the country.

Migration has recently taken on an added political dimension in the ten-nation region of Southern Africa because of the recent increase in the mechanization of the mines in the Republic of South Africa and the projected sharp decline in jobs for international migrants from "reserve" countries such as Botswana and Lesotho.[2/] In 1979, Botswana undertook an ambitious National Migration Study which involved four separate interviews with some 22,000 individuals over a 12-month period (see B. Brown, 1980; and J. Harris, 1981). Scholars analyzing migration from the labor "reserves" to the mines include Arrighi (1970) on Zimbabwe; Wolpe (1972) on South Africa; Murray (1977) and van der Wiel (1977) on Lesotho; Gordon (1977) on Namibia; and Elkan (1980) on Botswana, Swaziland, and Lesotho.

[1/] Studies of the massive outmigration from the Mossi plateau in Upper Volta to coastal countries such as Ghana and Ivory Coast include: Kohler (1972); ORSTOM (1975); Remy (1977); Songre (1973); and Coulibaly, Gregory, and Piche (1980). (The monograph by Coulibaly et al. is the first volume of a projected nine-volume series.)

[2/] See Bromberger's (1979) assessment of future job opportunities in mining in the Republic and the implications for nations supplying migrants--particularly Lesotho, Botswana, and Malawi.

There are substantial political, ethnic, and disease barriers to international mobility within Africa. Numerous countries vacillate over the question of immigrants. For example, Ghana was a large importer of foreign labor in the fifties and sixties but Ghana's Alien Compliance Order of 1969 and Ghana's stagnant economy of the 1970s have resulted in a substantial net emigration during the 1960-70 period. In the late seventies, the exodus increased and there are now an estimated one million Ghanaians living outside Ghana. Over the past 20 years, restrictions on international migration similar to Ghana's Alien Compliance Order have been imposed by other African countries in response to changing political priorities and economic conditions. Disease barriers also impede international migration. For example, the tsetse fly zone in middle Africa (which prevents permanent settlement because of sleeping sickness) occupies a land area equal to the size of the continental United States.

Who Benefits From Migration?

In general, migration studies show that migrants improve their income by moving but there are sharp differences by educational level. For example, in the Sierra Leone study, Byerlee, Tommy, and Fatoo (1976) found that the wage rate for educated migrants was three times the average rural wage rate but the unskilled urban migrant (working in the informal sector) was earning a wage only slightly higher than the rural wage after differences in the cost of living were taken into account. We have already pointed out that remittances are a major benefit of migration, ranging from 10 to 20 percent of the migrant's urban income in Africa. What is the social welfare impact of migration in both the sending and receiving areas? The neoclassical cost/benefit framework which concentrates on the private returns of migration is inadequate for evaluating the net welfare impact of migration. But can the political economy paradigm provide better answers to policy makers? The absence of quantification in political economy research on migration is noteworthy. It takes more than a string of assertions to prove that migration is the cause of underdevelopment in the source region. For example, Samir Amin (1974a) asserts that cost-benefit analysis is "an ideological defense, which takes the place of science, attempts to justify migratory phenomena by pretending that they are in the interest of both regions. . ." In an extremely balanced and constructive article, Knight and Lenta (1980) assess research by both neoclassical and political economy scholars on whether migration has underdeveloped the labor reserves in Southern Africa and conclude that there is no clear answer to the question on the basis of present research. Research on quantifying the social costs and returns to migration is urgently needed.

Synthesis and Research Direction

Although seasonal and rural-rural migration has occurred on a substantial scale in Africa, interregional wage differentials still exist within most African nations. For example, in Sierra Leone in 1974, the unskilled wage differential was almost 2 to 1 between the highest and lowest wage regions in the country. Rempel and House (1978) report there are still substantial differences among regions in the wage paid for unskilled labor in Kenya. The persistence of wage differentials will stimulate migration in the 1980s. Rural areas will have to absorb the bulk of the growth in the labor force over the next 10-20 years. Although the relative percentage of population in agriculture will decline in most countries, the absolute number of people in agriculture will likely increase in most countries over the next 10-20 years.

Long-distance migration will continue to be important in Southern Africa and from land-locked countries such as Mali and Upper Volta to coastal countries such as the Ivory Coast, Ghana, and Senegal. Although international migration can improve the real incomes of many thousands and perhaps millions of people each year, the failure rate will be high for migrants originating in poor rural households and in regions with unfavorable climate and natural resources. For example, a 1974 national survey in Sierra Leone revealed that two out of three uneducated rural-to-urban migrants returned to rural areas within five years. Moreover, in light of the growing political constraints on international migration and the projected sharp reduction of employment in the mines in the Republic of South Africa, increasingly solutions to rural poverty will have to be found within national boundaries in Botswana, Lesotho, and Swaziland.

This review adds support to Yap's (1977) finding about the limitations of most migration studies for policy purposes in the Third World. Although hundreds of migration studies have been carried out in Africa, few are well designed, comprehensive, and quantitative. The results of most sub-national, point-to-point, and cross-sectional studies yield information which is generally of limited value to policy makers. The descriptive studies carried out by sociologists, geographers, and demographers supported by the econometric studies show that the young and better educated are dominant in migration streams but these findings are only confirming what is already known. For a suggested research agenda from a neoclassical perspective, see Todaro's (1980) survey article. For a comparison between Marxist and non-Marxist approaches to the study of migration in Africa, see Gerold-Scheepers and Van Binsbergen (1978).

Migration studies include the following:

Bibliographies and Literature Reviews: Byerlee (1972); Yap (1977); Todaro (1976, 1980).

Africa General: Mitchell (1959); Berg (1965); Jackson (1969); Meillassoux (1975); Amselle (1976); Van Binsbergen and Meilink (1978); Rempel and Lobdell (1978); Shack and Skinner (1979); Peek and Standing (1979); Swamy (1981); Fortmann (1981); Seidman (1981).

Southern Africa: Wolpe (1972); Wilson (1972); Elkan (1980); Bromberger (1979); Knight and Lente (1980).

West Africa: Kuper (1965); Mabogunje (1972); Amin (1974a,b); Caldwell (1975); LeBris, Rey, and Samuel (1976); J. B. Riddell (1978); Guyer (1980a); Zachariah and Conde (1980); Byerlee (1980).

Central and Eastern Africa: Parkin (1975).

Botswana: Schapera (1947); B. Brown (1980); J. Harris (1981).

Gambia: de Jonge et al. (1978).

Ghana: Beals and Menezes (1970); Hill (1963); Caldwell (1969); Knight (1972); Hill (1978); Plange (1979); Schwimmer (1980).

Kenya: Rempel (1971); G. Johnson (1971); Fields (1975, 1980); Knowles and Anker (1981); Rempel and House (1978); House and Rempel (1980).

Lesotho: Van der Wiel (1977); Murray (1977); Eckert and Wykstra (1979).

Mauritania: Dussauze-Ingrand (1974).

Niger: Faulkingham and Thorbahn (1975).

Nigeria: Mabawonku (1978); Essang and Mabawonku (1974).

Senegal: Rocheteau (1975); Colvin et al. (1981); A. Adams (1977a,b); P. David (1980); de Jonge et al. (1978).

Sierra Leone: Byerlee, Tommy, and Fatoo (1976).

Upper Volta: Skinner (1965); Kohler (1972); ORSTOM (1975); Remy (1977); Songre (1973); Gregory (1979); Coulibaly et al. (1980).

Tanzania: Barnum and Sabot (1976); Collier (1979).

Togo: LeBris et al. (1976).

Uganda: Hutton (1973).

Zambia: Bates (1976); Cliffe (1978); Mwanza (1979).

Sahel: Caldwell (1975).

Migration Theory: Todaro (1969, 1976, 1980); Harris and Todaro (1970); Knight (1972); Byerlee (1974); Byerlee and Eicher (1974); Griffin (1976); Blomquist (1978); Rempel and Lobdell (1978); Gerold-Scheepers and Van Binsbergen (1978); Lipton (1980); Sabot (1981).

School Leavers: Hutton (1973); Callaway (1964).

Rural Employment

Growing unemployment in many African cities, explosive rates of urbanization, and rising urban wages created an awareness in the early 1960s that migration and employment generation had to be addressed by policy makers. For example, President Nyerere of Tanzania observed that economic policies and projects seemed to be geared to improving the lives of the urban people who were employed by the government and trade

unions. By the late 1960s, the growth of industrial employment was found to be lagging behind the rate of growth of industrial output in many African nations indicating that migration was in excess of the absorptive capacity in urban areas (C. R. Frank, 1971). The implications of these findings were that the industrial/urban sectors could not generate adequate jobs for rural to urban migrants and that attention should be directed to slowing down migration and generating more productive employment in rural areas (Eicher et al., 1970). These problems formed the agenda for two major conferences in East Africa. The 1966 Kericho, Kenya conference on employment and rural development (Sheffield, 1967) and Tanzania's 1967 Arusha Declaration (Nyerere, 1967, 1968, 1977) were manifestations of a search for a development strategy which addressed rural mobilization, equity, employment generation, and redressing the balance of rural and urban power.

Research on rural employment was a high priority research topic in the 1970s in countries such as Kenya, Nigeria, Ghana, Sierra Leone, and Botswana.[1/] Research on employment and income distribution in English-speaking countries has tended to be micro and quantitative (e.g., computing gini coefficients and factor price distortions). Research on employment in French-speaking nations generally has been historical, macro, and non-quantitative.

ILO country studies of employment in Kenya (ILO, 1972) and the Sudan (ILO, 1976) were pursued within a modified neoclassical (redistribution with growth) paradigm. The 600-page Kenya study was the output of 26 experts and it attracted considerable positive and negative reaction. The ILO team wisely rejected the concept of unemployment and the calculation of unemployment trends because they contended that few people have the luxury to be unemployed in Kenya's low wage economy. The question addressed in the ILO report was the causes of low productivity of labor and underemployment. The ILO mission identified the urban "informal sector" to be its major conceptual advance. The informal sector includes petty traders and artisians who generally earn low wages and returns. Although the ILO Kenya report contains an immense body of useful information, it made little contribution to a deeper understanding of the causes of rural poverty and underdevelopment and how to generate more employment in rural areas. Leys (1973) appraised the ILO report on Kenya from a political economy perspective and described it as a bland, innocuous report emphasizing redistribution with growth while glossing over the underlying structural causes of poverty and underdevelopment. For additional studies on employment in Kenya, see Clayton (1975); F. Stewart (1976); Child (1977); Rempel and House (1978); Ghai and Godfrey (1979); and Knowles and Anker (1981).

[1/] Although the number of research studies reported here is modest, we have reported extensively on employment research in other sections--see especially sections on smallholder farming, migration, and mechanization.

Winch's study (1976) of a large government-sponsored rice production program in northern Ghana illustrates the kind of micro information which is needed for policy debates on rural employment. On the basis of the input/output data which were collected daily over a 12-month period on 171 rice farms, Winch showed that a large-farm, capital-intensive rice production strategy would result in 17 percent more output than the small-farm (10-20 acres) strategy but it would result in a 77 percent reduction in the number of people employed. Net farm income would be about the same under both strategies but the small-farm strategy would spread income over 8,750 farmers, whereas the large-farm strategy would generate very high incomes for 200 to 400 farmers. For other studies in Ghana, see Hart's (1973) analysis of the urban informal sector and Steel's (1977 and 1979) studies of urban small-scale industry.

In Sierra Leone, major studies of migration, small-scale industry, fishing, and processing were carried out in 1974/75 in conjunction with a nationwide farm survey by a team of researchers from Njala University College, University of Sierra Leone, and Michigan State University. The study was directed by D. S. C. Spencer. The studies revealed that a small producer strategy of farming, rice processing, fishing, and rural industry would be consistent with a growth with equity strategy of rural mobilization and employment generation. That small is "beautiful," profitable, and meets equity (employment) objectives is probably better documented by empirical evidence in Sierra Leone than in any other country in Africa. A summary of rural employment research in Sierra Leone is reported in Byerlee, Eicher et al. (1982). Specific studies include Spencer (1976); Spencer and Byerlee (1976); Spencer, May-Parker, and Rose (1976); Linsenmeyer (1976); R. P. King and Byerlee (1978); Byerlee, Tommy, and Fatoo (1976); Byerlee et al. (1977); and Liedholm and Chuta (1976).

Michael Lipton's (1978) study of employment and labor use in Botswana was a year-long effort to diagnose the causes of underemployment and what the government can do to generate more productive employment. He presented hundreds of recommendations on how to increase the productivity of the self-employed and generate new jobs--a staggering task in light of the projected decline in jobs for Botswana migrants in the mining industry in the Republic of South Africa over the next 20 years.

Women in Development

Research on women in African development has a long history. The importance of women in farming was recognized over 50 years ago by Baumann in his classic article, "The Division of Work According to Sex in African Hoe Culture," which appeared in Volume I of Africa (Baumann, 1928). Kaberry's (1952) study of women in the Cameroon is a standard reference. One of the first studies to present empirical data on the

differentiation of adult male and female activities was Nigerian Cocoa Farmers (1956) by Galletti, Baldwin, and Dina.

Research on women in Africa mushroomed in the 1970s following the publication of Ester Boserup's influential Woman's Role in Economic Development (1970).[1/] Boserup, a Danish social scientist, provided evidence to show that women in the Third World play significant roles in agricultural and rural development. Boserup pointed out that there were major regional differences in the role that women play in farming in the Third World and that Africa could be described as the "region of female farming par excellence." She drew on several case studies and surveys to show that women often "do more than half of the agricultural work; in some cases they were found to do around 70 percent and in one case nearly 80 percent of the total" (p. 22). She also showed that women play a major role in local trade in Africa, particularly in West Africa. Boserup urged researchers, policy makers, and donor agencies to give more attention to the role of women in development projects and in research.[2/]

Boserup's timely analysis has led to a number of polemics on the adverse effects of development on women (Tinker, 1976)[3/] but has also sparked a large amount of serious research on women as illustrated in the bibliographies by Buvinic et al. (1976) and Mascarenhas and Mbilinyi (1980). Two women have been in the forefront of research for a decade: Achola Pala from Kenya and Marjorie Mbilinyi from Tanzania. Mbilinyi's (1972) paper on the division of labor in African societies and Pala's (1976) research on women in Kenya and her analysis of research priorities are required reading.

The celebration of International Women's Year in Mexico City in 1975 gave added impetus for action programs to help women. Special development projects for women are now underway in many African countries and funding is increasing for research on women in development. Unfortunately, many foreign aid financed programs to "help" African women will likely end in failure because many African policy makers do not want advice

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[1/] Boserup was an established scholar (see Boserup, 1965) before she turned to research on women. Boserup's book touched off a stream of papers, seminars, workshops on women in development, and special projects to help women. Boserup's book did for research on women what Todaro's (1969) model did for research on migration in the 1970s.

[2/] Boserup argued that men usually monopolize the use of new equipment and agricultural methods and this tendency is frequently reinforced by a bias in extension programs in favor of men. As a result, there may be a relative decline in the productivity of women and "the corollary of the relative decline in women's labor productivity is a decline in their relative status" (p. 53).

[3/] For example, Tinker claims that in virtually all countries and in all classes women have lost ground relative to men. She attributes this "deplorable phenomenon" to development planners, who use "mythical stereotypes as the base for their development plans." Even regarding subsistence societies, Tinker claims that women's roles "often add up to near serfdom" (1976, pp. 22-24).

from outsiders on this sensitive issue and because action programs are two to five years ahead of the research base in many countries.

Empirical Results

The focus of most current research is on describing how women participate in the development process, identifying constraints on the expansion of employment opportunities, and measuring whether women gain or lose in the development process. Common methodological problems in many studies on women include the failure to study how men, women, and children participate in and are affected by the development process and the tendency to move directly from a few descriptive findings to recommendations for foreign aid to help women.

The role of women in the colonial period is starting to be clarified through historical research. For example, Young's analysis (1977) of women's role during the colonial period in Mozambique questions the widely held stereotype that women only produce food crops in Africa. Young showed that as the terms of trade for food and cash crops changed and as more men pursued off-farm employment, women became important producers of both food and cash crops during the latter part of Mozambique's colonial history. Sudarkasa's (1973) study of Yoruba market women in Nigeria is also an important reference. Sudarkasa cautions against overgeneralization. She points out that women have played a pervasive role in trading in West Africa but in East Africa men of Asian background dominated trading for many years. In a recent paper, Ann Seidman argues that technological change has contributed to the deterioration of the status of women in Africa but she does not present hard data to support her assertion (1981, p. 122).

Dunstan Spencer (1976) evaluated the impact of development interventions on women's workload by interviewing 23 rural households in Sierra Leone twice a week for one year; 14 of the 23 were rural households participating in a World Bank financed rice project in the eastern province while the other nine households were non-participants selected at random in the same province. Spencer's results revealed that the workload of the women in households participating in the rice project increased slightly while the workload of the men and male children was substantially increased during the first three years of the project. Spencer rejected the hypothesis that women's workload increases relative to men as commercialization of agriculture proceeds but noted that his sample was small and more research was needed on the impact of technical change on men and women in different ethnic groups and farming systems. Spencer's research is noteworthy because he moved beyond the typical one-shot survey and studied labor allocation of men, women, and children in a micro-environment through repeated interviews over a 12-month period. A problem in reporting on the effects of technical change on women is that

households which adopt new technologies are often structurally different than non-adopting households. For example, comparisons of mean hours worked may misrepresent differences in hours worked due to other factors, such as economies of scale in performing household tasks if the households adopting technical change are larger in size than non-adopting households. Once again, this points up the pitfalls of using sample averages.

K. Shapiro (1978) drew on the data collected in his 1970-71 farm management study in a smallholder cotton production area in northwestern Tanzania to answer the question of what would happen if a village water system eliminated the need for women to fetch water from distant streams and wells. Would the women simply increase their leisure or would they invest their released time in agricultural production or non-farm activities? Shapiro analyzed the work tasks of all males and females 19 to 60 years old and found that the average woman in his sample of 70 farm households spent 90 minutes per day or 556 hours per year fetching water. The results showed that even if one considers only that female labor released during the peak period--October to December--(when female labor clearly has a positive MVP in agriculture) then nearly 140 additional hours would be available for work in cotton fields or in some other enterprise. Do women work harder than men? Shapiro found in his sample of 70 families that although men devoted more time to farming than did women, women worked 28 percent more total hours per year on farming and non-farming activities than men.

Barrett et al. (1982) reported that in eastern Upper Volta men worked more total hours in farming during the 1978/79 survey year than women but women worked more hours per year when household tasks were taken into consideration. Barrett et al. found that women in hand hoe households which had adopted animal traction worked substantially fewer hours than women while the difference in hours worked by men was insignificant.

The impact of male migration on families left behind in the village is central to the analysis of migration. Staudt (1975) interviewed 212 small-scale farm households in densely populated western Kenya in 1975 and found that 40 percent of the rural households were headed by females because the male had temporarily or permanently migrated to urban areas in search of work. Moock (1976) interviewed 152 maize farmers in western Kenya and found that one-third of the male heads of rural households were away from home engaged in or searching for work. Moock compared the technical efficiency of male vs. female managed small-scale maize farms and found that education of women had a more significant impact on maize output than the education of males, that male educational achievement was correlated with success in off-farm employment, and that female farm managers did not seem to benefit as much as the males do from extension contact. (The latter finding may be explained by the fact that most of the extension agents were predominately male at the time of Moock's survey.)

Emmy Simmons' studies (1975 and 1976b) in northern Nigeria illustrate the conceptual problems involved in estimating the income of Moslem households where women are secluded in their compounds (homes) during the daylight hours through a form of purdah. Simmons (1975) studied women who prepared processed food in their compounds which was sold by their children in the village markets. She stressed the need to include the income of females engaged in such activities as trading and food processing in farm management surveys and she observed that female enumerators were needed to gain access to women in purdah.

Needed Research

Over the past ten years, numerous studies have shown that a significant portion of the labor inputs in agriculture in sub-Saharan Africa comes from women, except for the physically demanding tasks such as the brushing and felling of trees. Women dominate some activities such as weeding, food processing, and trading, and participate in almost all other farming activities, depending on the farming systems and social and climatic factors. But it is a vast overgeneralization to argue (as some popular writers and members of donor agencies do) that women produce 60-80 percent of the food in Africa. Current research is attempting to understand how women participate in and are affected by the development process. For a perspective covering the 1970-80 period, see Boserup (1980a,b).

Research, in our judgment, should move beyond descriptive and anecdotal studies to more quantitative research on the rural household, including the role of women and men in different farming and livestock systems and off-farm employment and the role of women and men in household decision making. Research should also examine how institutions influence women's access to credit, seed, extension services, and education. For studies on women, see Mbilinyi (1972); Eialam (1973); Robertson (1974); B. A. Clark (1975); Chuta (1978); Hafkin and Bay (1976); Lancaster (1976); Sudarkasa (1973); Spencer (1976); Young (1977); Gordon (1978); Achola Pala (1976); Bukh (1979); Staudt (1978/79); Issard (1979); Tripp (1978); M. Saul (1980); Urdang (1980); and Guyer (1980a,b); Savane (1981); Fortmann (1981); Seidman (1981); Goody and Buckley (1977).

Rural Small-Scale Industry

Small-scale industry[1/] accounts for most industrial employment and output throughout Africa. For example, Liedholm and Chuta (1976) estimated that 95 percent of the

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[1/] The definition of rural small-scale industry varies from country to country, within countries, and among government agencies. Definitions also change over time. Chuta and Liedholm (1979) found 50 different definitions used in 75 countries in their literature review. We have defined small-scale as those establishments employing fewer than 50 people.

people engaged in industrial production in Sierra Leone were working in firms with less than 50 employees. Moreover, farm management surveys have shown that as much as 25 to 50 percent of the annual labor supply of rural households in sub-Saharan Africa is spent on off-farm activities such as small-scale industry, rural public works and trading. Since rural industries and agricultural production are clearly linked through both factor and product markets, it is important to review research on rural industries in Africa. For a review of the literature on rural small-scale industry in the Third World, see Morawetz (1974) and Anderson and Leiserson (1980); and in Africa, see Chuta and Liedholm (1979) and Page (1979).

Theoretical Issues

Most studies of industrial production in the 1960s in Africa focused on urban large-scale firms, accepting the analytical framework of dual sector models. Later dual sector models were modified by Hymer and Resnick (1969), Byerlee and Eicher (1974), and House and Killick (1980) to include the urban informal sector. Hymer and Resnick (1969) incorporated off-farm activities as a separate sector; they hypothesized that the products of rural small-scale industries were inferior goods--have negative income elasticities of demand. But Hymer and Resnick provided no empirical support to test their model.

The role of rural small-scale industries in economic development over time will be largely determined by the linkages between the rural area and regional, national, and international markets; composition of demand for products of the sector; the efficiency of the sector relative to larger-scale modes of production; and factors affecting the supply responsiveness of small firms. One of the most important theoretical relationships between rural industry and agriculture is the allocation of rural household labor to farming and off-farm employment. Data from throughout Africa show that the amount of time devoted to nonagricultural activities is significantly related to seasonal labor requirements in agriculture. In northern Nigeria, for example, Luning (1967) found that the percentage of people primarily engaged in non-agricultural activities dropped from 65 percent in the slack season to only 6 percent during the peak farming season. Similarly, Norman (1969) found that 27 percent of family labor in villages surveyed in northern Nigeria was devoted to nonfarm activities even during peak farming months, down from nearly 80 percent during slack months.

Empirical Results

Research on rural small-scale activities in the 1960s was undertaken in Nigeria by Kilby (1962), Callaway (1964), and Luning (1967); and in Tanzania by Schadler (1968). In 1973 Liedholm reported that although surveys of small-scale industry had been carried out in 11 African countries, most of the surveys focused on the urban informal sector and in

the larger rural towns rather than in the villages. In the 1960s, most research on the rural small-scale industries was unsystematic, primarily generating data through ad hoc case studies. During the 1970s, procedures for collecting stock and flow (input-output) data on rural small-scale industries were refined and valuable surveys were carried out in several countries, including Botswana (Lewycky, 1977); Ghana (Steel, 1977); Kenya (Child, 1977; K. King, 1977; Forsyth, 1977; and F. Stewart, 1979); Cameroon (Steel, 1979); Sierra Leone (Liedholm and Chuta, 1976); Nigeria (Mabawonku, 1978); Upper Volta (Wilcock, 1981); and Kenya, Tanzania, and Zambia (Gulhati, 1981).

Research has shown that the primary orientation of rural small-scale industries is toward production and provision of goods and services for local markets. The composition of small-scale industries seems to be quite similar throughout Africa. The most prominent activity in terms of employment is tailoring, followed by carpentry, blacksmithing, baking, and vehicle repair activities. Traditional activities such as blacksmithing and weaving are more important in villages, while tailoring and vehicle repair assume greater importance in small towns (Chuta and Liedholm, 1979).

The three sources of demand for the products of rural small-scale industries are: (1) local demand from rural and urban consumers, (2) export markets, and (3) demand arising from backward and forward linkages. The growth of small-scale industries will depend upon the sign and size of the income elasticities of demand for goods produced for each of these three markets. Liedholm (1973) reviewed the few consumer budget surveys available in sub-Saharan Africa and found that the income elasticity of demand for these goods and services was positive (Leurquin, 1960; Massell, 1969); he concluded that more research was needed on the relative income elasticities of locally produced versus imported goods. The Hymer-Resnick "inferior goods" hypothesis (1969) of low expenditure elasticities was tested in a nationwide consumption survey in Sierra Leone by R. P. King and Byerlee (1978). The results show that the expenditure elasticity coefficient for rural small-scale industry products was positive and rather high (0.9). Although the King/Byerlee results are cross-sectional and for only Sierra Leone, they suggest that the Hymer-Resnick prognosis of poor market prospects for small-scale industries should be questioned until more research is completed.[1/] Chuta (1978) has shown that the export demand in high-income countries for products such as gara tie dye cloth produced in Sierra Leone appears to be quite high. An additional source of demand for the products of small-scale

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[1/] The finding that the expenditure elasticities of demand for rural small-scale industry products are high and positive, but under one, does not necessarily conflict with Resnick's observation that in a long-run historical perspective there has been a tendency for artisans and rural small-scale firms to account for a declining proportion of the national product. See Resnick's (1970) description of the decline of SSI in Burma, Philippines, and Thailand over the period 1870-1938.

industry arises from backward and forward linkages with the agricultural and large-scale industrial sectors. While the linkages between large- and small-scale industries have been found to be quite limited in most African countries, there is little empirical research on the magnitude of linkages between small-scale industry and agricultural production and processing.

The belief that rural small-scale industries have a major role to play in African economic development has been considerably enhanced by recent evidence that rural small-scale industries are efficient and profitable and because small-scale firms generally have low capital/labor ratios, jobs can be generated with small capital outlays. In Sierra Leone, for example, the capital per worker for small-scale industries was about $400 as compared with $7,300 for large-scale firms with 50 or more workers (Liedholm and Chuta, 1976). Steel (1977) found that the original capital cost per worker in Ghana averaged $435 in firms with family labor and no wage workers, while it was approximately $9,000 per worker in firms with over 100 workers. Wilcock (1981) reports that an average initial capital per firm in Eastern Upper Volta was $435. Child (1977) found that the cost of capital per job in the modern sector of Kenya was three times higher than in small-scale firms. The output/capital ratio for small-scale industries was found to be higher than that of large-scale industries in Sierra Leone (Chuta and Liedholm, 1979).

Available evidence from both Kenya and Sierra Leone shows that small-scale firms can generate high rates of financial and economic returns. From a dynamic perspective, there appears to be no reason why small-scale industries should have difficulty in responding to increases in demand in most African countries during the foreseeable future. In general, small firms are easy to establish because the costs of entry are low. For example, half of the firms Child surveyed in Kenya started with an initial investment of $140 or less. In Sierra Leone the mean initial investment was less than $90 (Liedholm and Chuta, 1976). Most studies, in fact, show that established small-scale firms tend to be overcapitalized and, therefore, have excess capacity. Given sufficient adjustment time, trained labor should not be a constraint because small-scale firms in most countries tend to train their own labor through various apprentice systems (Callaway, 1964; Kilby, 1962; Child, 1977; K. King, 1977; van Rensburg, 1978; Mabawonku, 1978; Steel, 1979; Wilcock, 1981).

Policy Direction

The small but growing research on rural small-scale industry has pointed up the strategic importance of this subsector. The growing evidence that small-scale industries generate more employment and output per unit of capital than their large-scale counterparts should be seriously heeded by policymakers. Moreover, studies of the failure of

capital-intensive techniques are widespread. For example, Linda Freeman's (1980) report on the failure of baking bread with electric ovens in Tanzania (which were financed by Canadian foreign aid) is a sobering reminder that modern is not always more profitable and socially desirable. Rural small-scale industries in Kenya, Nigeria, Ghana, and Sierra Leone have been found to be more efficient, more profitable, and to have lower capital/labor and higher output/capital ratios than large-scale industries.[1/] For these and other reasons, it behooves policymakers to turn their attention to policies and programs to stimulate rural small-scale industries. What should policymakers do?

On the demand side, it is obvious that the growth of agricultural production and the income of farmers is of strategic importance in providing the demand for rural small-scale industries. As a result, efforts to promote rural small-scale industry should be an integral part of a strategy to raise rural incomes. Piecemeal attempts (training programs and credit) to promote rural small-scale industry in Africa in the 1980s are likely to be ineffective unless they are part of a broader rural mobilization strategy. The centerpiece of a rural mobilization strategy should be raising agricultural production and incomes which in turn will provide the effective demand for the products of rural small-scale industries.

Turning to the supply side, the obvious starting point in helping rural small-scale industries is to eliminate or reduce the subsidies and policies which directly and indirectly help large-scale industries. Beyond that, there are few general policy guidelines except to avoid the knee jerk reaction of showering subsidized credit on small-scale industries because this will likely induce capital for labor substitution and reduce employment which is one of the major potential benefits of rural small-scale industry. One constraint on small-scale firms appears to be inadequate managerial training but at this time there is no general policy guidance on the type of training which can be most cost effective. For example, in Sierra Leone, increased formal education cannot be expected to improve the profitability of small-scale firms because Liedholm and Chuta (1976) found no evidence of a correlation between the formal education of the proprietor and the economic profitability of the firm. Efforts to develop an industrial extension system to assist managers have

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[1/] But it is necessary to go beyond comparisons of small- and large-scale industry and analyze the returns to farming and rural small-scale industry (SSI). For example, although SSI may be labor-intensive relative to large-scale firms, the SSI firms may be capital-intensive relative to farming activities. Moreover, if the capital requirements for establishing SSI are large relative to the incomes of poorer rural households, it may open the door for higher-income rural households to engage in rural SSI. Therefore, policies to stimulate demand for SSI products or to partially subsidize the costs of SSI firms may tend to worsen rural income inequality even though they may narrow the gap between rural and urban areas (see Baker, 1981).

not proven very successful in Kenya because of an inability to distinguish between the general needs of the small firms and larger firms with more specific needs (Livingstone, 1977a).

Research Direction

Problems of small-scale industries should prove to be a fertile ground for researchers in the 1980s. The starting point for research is to acknowledge that rural small-scale industry cannot be understood either analytically or for policy purposes except in relationship to the rural economy, to the industrial sector, and to society at large. Research on rural small-scale industries should be pursued in tandem with research on large-scale industry and in conjunction with surveys of consumption patterns and farming systems research. There is a danger that rural small-scale industry will be oversold just as cottage industries were oversold in India and in many Asian countries in the community development era of the 1950s and import substituting industrialization was oversold in Latin America in the 1960s. The future of rural small-scale industry is linked to the willingness of African governments to implement policies to increase rural purchasing power.

More research is needed on the following: (a) What are the savings and reinvestment rates and patterns of both small- and large-scale industries in both the short- and long-run? (b) What can be done to promote backward and forward linkages between rural small-scale industries and agricultural production, processing, and large-scale industries? (c) What are the determinants of entrepreneurship? (d) What type of educational and managerial assistance is needed to help rural small-scale industries? (See Chuta et al., 1981.)

Fisheries

Fishing is both economically and nutritionally important to the people of Africa. Fish appears to be the least expensive source of animal protein in Africa and its overall nutritional value compares favorably to beef and eggs (Deelstra, White, and Wiggins, 1974). Africans consume somewhat over nine kilograms of fish per person annually compared with an estimated six kgs. in Latin America and nine kgs. for Asians, but there is wide variation in per capita fish consumption. FAO data for 34 sub-Saharan countries indicate, for example, that fish contribute more than 40 percent of all animal protein in 12 countries, between 20 and 40 percent in 13 countries, and under 20 percent in 9 countries (FAO, 1976d).

The annual catch in sub-Saharan Africa has been estimated to be around 3.5 million tons. About 60 percent of the catch comes from marine (offshore) fisheries and about 40 percent from inland fisheries. The primary marine fisheries are located on the west coast

of Africa between the Tropic of Cancer and Capricorn, and off the east coast of Somalia and Kenya. Of the approximately 1.4 million metric tons of fish taken annually from freshwater fisheries, around half is from lakes and reservoirs with the rest being caught in rivers and floodplains (FAO, 1976d).

In West Africa, fish are usually salted, dried, or smoked for preservation during transport and distribution. In eastern African countries such as Kenya, 60 to 70 percent of fish are sold fresh for local consumption. Frozen fish, both domestic and imported, are becoming increasingly popular in urban areas, but are not likely to supplant dried fish among rural consumers (Krone, 1970). There is some evidence that fish has been substituted for meat in recent years because of rising meat prices (Staatz, 1979). There is also evidence, however, that demand varies widely for different types of fish (Bates, 1976). The income elasticity of demand for fish is thought to be quite high, around .9 to 1, but evidence is scanty. V. E. Smith, Strauss, and Schmidt (1981) showed that the expenditure elasticity for fresh fish in Sierra Leone in 1974-75 ranged from .88 to 1.36 depending on the mean expenditure level while expenditure elasticities for dried fish ranged from .51 for low expenditure households up to 1.92 for high expenditure households.

Despite the importance of fish in African diets and the role of fishing as a source of employment and income, Africans appear to be under-exploiting their fishery resources relative to other regions. While some of the major lakes such as Lake Victoria and Lake Tanganyika are heavily exploited (Oduro-Otieno et al., 1978), the FAO (1976d) estimates that the catch from the major lakes of Africa can be doubled. The supply of fish is constrained by an extremely low level of productivity among artisan (small-scale) fishermen and by insufficient large-scale fleets owned by Africans. For overviews on inland and marine fisheries, see Jackson (1971); Msangi and Griffin (1974); Crutchfield and Lawson (1974); FAO (1976d); and Kollberg (1979).

Small-Scale (Artisan) Fishing

Small-scale or artisan fishing accounts for as much as 95 percent of the annual catch in sub-Saharan Africa. Since most fishing is carried out on a seasonal basis, estimates of the number of people engaged in fishing are unreliable. Even full-time fishermen, such as the Addi canoe fishermen off the Ghanian coast, generally go to sea an average of only 150 to 160 days a year (Mansvelt-Beck and Sterkenburg, 1976). Half of the annual catch is generally taken during the two or three most active fishing months. Part-time fishermen often fish during the flood season to supplement their diets, especially before harvesting staple food crops. While most small-scale firms primarily rely on family labor, it is common to hire additional labor with the proportion of

man-hours supplied by hired labor increasing with firm size. In Sierra Leone, 90 percent of wages were paid in kind (Linsenmeyer, 1976) while in Kenya cash wages are the standard practice.

A wide range of technologies is employed by fishermen in exploiting marine and freshwater fisheries. Small one-man canoes are often used in shallow water in conjunction with cast nets. One of the most profitable types of small-scale fishing relies on large, traditional boats equipped with outboard motors. Linsenmeyer's (1976) economic study of alternative technologies in Sierra Leone revealed that the returns per person are approximately the same for seven combinations of boats and nets used in small-scale fishing. He also found that the returns were similar for paddled and motorized canoes despite the greater capital costs of larger canoes because they could go further to sea, getting a larger, more consistent catch.

Christensen (1977) analyzed rapid technological change in the Fanti fishing economy on the coast of Ghana. Christensen, an anthropologist, returned to an area he had studied 25 years earlier and found that the Fanti combatted declining yields by replacing traditional canoes with larger motorized canoes, leading to concentration of ownership in the hands of a few individuals who are able to secure capital for initial investments and for subsequent maintenance. Because of the larger investment for equipment, owners of the motorized boats now receive a much larger share of the catch. Christensen noted that, increasingly, market women provide capital for boats and motors. As a result, female control of the industry is enhanced and the industry is being divided into classes of owners and crews, an ominous sign for the future of small-scale fishing.

Large-Scale Fishing

Although 95 percent of the fish in sub-Saharan Africa are caught by small-scale fishermen, sea-going trawlers are growing in importance. Between 1960 and 1970, catches by long-range foreign-operated vessels increased five-fold while local fishermen increased their off-shore catch by only 80 percent (Christy, 1976). As a result, foreign-owned vessels now dominate coastal fishing (Okidi, 1978, 1979; Linsenmeyer, 1976).

While large-scale fishing based on sea-going vessels has been favored by many planners in coastal countries, there are few comparative studies on the income and employment effects of large- versus small-scale fishing in Africa. Linsenmeyer's (1976) study of the economics of small- and large-scale fishing in Sierra Leone is one of the few comparative studies in West Africa. Linsenmeyer's 12-month survey in 1974/75 covered 93 small-scale firms in five randomly selected sites on the coast of Sierra Leone. Linsenmeyer found that the capital/output ratio in small-scale fishing firms was about half that of large-scale firms and the capital/labor ratio was .05 in small-scale fishing and

.44 in large-scale firms. Linsenmeyer concluded that small-scale units were economically more profitable and capable of producing fish at considerably lower cost per ton than large-scale firms but he was able to secure accurate input/output data for only three of eleven large-scale vessels. Linsenmeyer urged the government of Sierra Leone to stop favoring large-scale firms through subsidized credit and favorable import duties on parts and equipment.

Fisheries Management

In general, fishing trends throughout Africa over the last several decades have been toward increased fishing intensity, geographical expansion to offshore waters, and decreasing catch rates. Many basic problems impede expansion of the industry. For example, artisan fishing is highly seasonal, spoilage rates exceeding 40 percent are common, and many shoreline fisheries have been over-exploited as a result of fishermen using small meshed nets in an attempt to sustain yields. There is little applied research, extension, and technical assistance available to small-scale fishermen. Further, it is difficult to increase production of small-scale fishing since many fishermen are itinerant, moving along shores in search of their catches, and investments in artisan fishing often have very low returns. Another key problem in artisan fisheries development is that fishing areas are often geographically separated from major consumption centers.

Rational management of Africa's fishery resources is clearly required. One of the main fisheries management issues during the last decade has been how to achieve a balance between policies to help increase the productivity and livelihood of fishermen versus those designed to stem the declining offtake of preferred species. Kudhongania and Cordone (1974) point out, for example, in their study of fisheries in the Tanzanian part of Lake Victoria that fishermen have tended to overfish some species and underfish others and, therefore, many of the commercially preferred species may not have the biotic potential to sustain yields under present fishing regimes. Attempts to counter the downward trend in fish catches include prohibiting small meshed gill nets, introducing fast growing and breeding species, and constructing fish ponds.

Most of the research on fisheries to date has been dominated by technical scientists who have focused on identifying the primary factors affecting potential yields of specific populations in particular bodies of water. Although modelling efforts are shifting toward the development of ecosystem models (Ita, 1975), the economics of fishery management has received little attention. Gulland (1973) and Ita (1975) show that biological and economic assessments of fisheries must go hand in hand. Ita argues that a key in fishery management is to relate ecological and economic changes to fishing intensity. Gulland (1973) takes a pragmatic approach to research on fishery management in arguing that the

key is to start with the question of how do present catches compare with potential yields. Gulland contends that technical and economic questions are most important when a stock is under-exploited relative to its potential and that the precision of biological information is much more important when stocks of fish are heavily exploited. Gulland says that, in general, the following information is needed for rational fisheries management: (1) sustainable yields of the major species, (2) seasonal patterns of supply, (3) major landing places, (4) the best gear to use, and (5) the likely catch for each type of gear. For discussions of the issues involved in the development of fisheries management, see Krone (1970); Okedi (1974); Msangi and Griffin (1974); Crutchfield and Lawson (1974); Okidi (1978, 1979); Oduor-Otieno et al. (1978); Kollberg (1979); and Saila and Roedel (1979).

Fish Ponds

Fish ponds (aquaculture) appear promising in several Central African countries but numerous problems have plagued this type of production for 30 years. Fish ponds were initiated in Central Africa by the Belgians in the early 1950s and the French followed with construction programs in the Central African Republic and Cameroon. Later fish ponds were built in the Ivory Coast, Ghana, Nigeria, and Zaire. Pond construction peaked in the late 1950s, with many ponds falling into disuse during the postindependence period. Fish ponds have experienced many problems including building, stocking, and maintaining ponds, and because of high cost of the fish relative to rural incomes. Interest in fish ponds was revived in the mid-1960s and programs to rebuild ponds were launched in several countries. While fish ponds appear to be an important potential source of high quality protein, severe technical problems have been encountered in attempts to establish ponds at the village level, including lack of supplies of fish food, identification of appropriate fish species, and the preponderance of very small ponds. Technical assistance for fish culture development has primarily come from the French organization, Centre Technique Forestier Tropical, the University of Rhode Island and Auburn University in the U.S., and the U.S. Peace Corps. For reviews of fish pond programs and prospects in Africa, see FAO (1976d).

Research Direction

Policy makers and researchers need to examine the economics of fish versus meat in meeting protein needs, small- versus large-scale fishing, inland versus offshore fishing, and fish ponds. Numerous African governments and some donor agencies are explicitly and implicitly promoting large-scale fishing via subsidies, tariff structures, research, and technical assistance. Since small-scale fishermen (like small farmers) are unorganized and are mainly seasonal producers, they have had little voice in bringing about a change in government investment, research, and extension programs in support of small-scale

production. Research on small-scale fishing should be carried out in conjunction with research on fish processing and marketing since increased productivity will likely have a minimal impact on the profitability of small-scale fishing unless marketing is also improved.

Recovery of the Sahel

In this section, we present a case study of research on national and international efforts to promote an equitable and ecologically sound pattern of development in the Sahel following the drought of the early 1970s. The six-year drought from 1968-74 had a devastating impact on the lives of millions of the estimated 30 million people in the Sahelian region of West Africa.[1/] Sahel is an Arabic word meaning the edge of the desert. In ecological terms, the Sahel is the belt of land along the southern edge of the Sahara desert from the Atlantic Ocean to Lake Chad, with annual rainfall varying from 150 mm to 500 mm (Swift, 1977). In political terms, the Sahel refers to eight countries: six French-speaking countries--Mauritania, Senegal, Mali, Upper Volta, Niger, and Chad; one English-speaking country--the Gambia; and one Portuguese-speaking country--Cape Verde islands with a population of 300,000 off the shore of Senegal.

The Sahel is a poor region. All eight countries are included in the World Bank's (1981) list of low-income countries (see Table 1). The staple foods in the region are millet and sorghum except in Senegal and the Gambia where rice is important in local diets. Cotton and groundnuts are major export crops, while livestock dominates the economies of Mauritania and Mali. The Sahel is noted for its large variation in the amount, timing, and geographical spacing of rainfall. The extreme variation in rainfall is illustrated in northern Senegal where the theoretical carrying capacity for cattle ranged from 187 per 1,000 ha in a "normal" good year, to 87 in a "normal" bad year, and 0 in 1972--a disastrous year at the peak of the drought (Swift, 1977, p. 458).

The Sahelian countries established a permanent secretariat called CILSS[2/] in Ouagadougou during the drought in order to coordinate their requests for emergency relief. The drought brought forth a massive relief effort--mainly food grain--from Western Europe and North America. Major donor nations organized a Secretariat--Club du Sahel--in the OECD Headquarters in Paris to coordinate donor assistance for relief and recovery of the Sahel. CILSS and the Club du Sahel have a close working relationship; they have jointly published a number of excellent studies. The history of the drought and relief operations is covered in Dalby and Church (1973); Bernus and Savonnet (1973); Sheets and Morris

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[1/] For bibliographies, see Joyce and Beudot (1976/77) and the Sahel Bibliographic Bulletin (1977-1981).

[2/] Permanent Interstate Committee for Drought Control in the Sahel.

(1974), Disaster in the Desert; Caldwell (1975); and indispensable collections by Copans (1975); Glantz (1976); and Dalby, Harrison, and Bezzaz (1977). For a skeptical view of foreign aid, see Meillassoux (1974), "Development or Exploitation: Is the Sahel Famine Good Business?"

As the relief effort phased down in 1974 and 1975, the Sahelian nations through CILLS and the major donors through the Club du Sahel jointly adopted food self-sufficiency[1/] and self-sustaining economic development as the goals of a long-term recovery program for the 1975-2000 period. The FAO's strategy paper, Perspective Study on Agricultural Development in the Sahelian Countries: 1975-1980 (1976c), was a basic document used by CILSS and the Club du Sahel in developing their long-term recovery plans. The Club du Sahel's strategy is found in Club du Sahel (1977) and CILSS/Club du Sahel proposals for the recovery of the Sahel include CILSS/Club du Sahel (1977; 1978a,b; 1979; 1980a,b). The U.S. strategy for the recovery of the Sahel was published as AID (1976). The architect of USAID's strategy--David Shear--summarizes the U.S. strategy in Shear and Clark (1976). The U.S. strategy for river basin development is spelled out in AID (1978).

Research Findings

Climate

During the drought, two critical questions about climate were frequently debated. First, was the 1968/74 drought a manifestation of a permanent shift in the climate in the Sahel resulting from clearing of land, burning, and overgrazing? This question still cannot be answered because benchmark data are not available. But a major weather monitoring program is underway by the World Meterological Survey with its headquarters in Niamey, Niger. The second question was the probability of the reoccurrence of drought in the 1980s and 1990s--a crucial question for recovery plans. Economic historians, Lovejoy and Baier (1975) and Baier (1976, 1977), studied the occurrence of drought in the Sahel over the past 200 years and found that the period was marked by wet and dry rhythms of irregular length and by two major droughts over the 1900-1968 period. Baier, Lovejoy, and other researchers concluded that there was no evidence to suggest that a major drought will recur at any greater frequency than it has over the past several hundred years.

Desert Encroachment

Throughout the 1968-74 drought, there was considerable debate on the question of desert encroachment. The international press played up the number of hectares of

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[1/] Food self-sufficiency implied regional and not national food self-sufficiency in all basic foods (see Club du Sahel, 1977).

farmland that were being permanently "lost" each year as the Sahara desert moved southward and "converted" grazing and farm land into desert. Lovejoy and Baier's (1975) and Diarra's (1975) seminal articles on the "drought/recovery cycle" revealed that the pastoralists and farmers have historically moved back and forth between the Sahelian and Savannah ecological zones like a finely tuned accordian; the authors believed that the return of normal rainfall in the Sahel would convert the encroached land back to grazing and farm land in the same pattern that occurred over the past several hundred years. The research of Diarra, Baier, Lovejoy, and Horowitz (1972, 1977) stressed the positive role of the mobility of people and livestock in response to drought; they cautioned against establishing fenced ranching schemes and they encouraged governments to facilitate livestock transhumance through the development of water points and marked corridors.

Demography

Despite widespread reports in the international press about the death of hundreds of thousands of people during the drought, Caldwell (1975) reported that the loss of human life was modest and that the remarkable feature of the drought was the ability of the population to survive a six-year drought. The impact of the drought on the demography of a village in Niger is reported by Faulkingham and Thorbahn (1975) and Faulkingham (1977). The impact of the drought on farming and livestock is recorded in an indispensable collection by Gallais (1977); Swift (1977); and an AID workshop on livestock (AID, 1980).

Overcoming Food Dependency

The USDA (1981) has shown that lagging food production in the Sahel cannot be reversed overnight and that rice and wheat imports are going to be a critical problem in some Sahelian countries throughout the 1980s. In our judgment, the recovery of the Sahel will be a long and painful process because (1) there is little that can be done in the short run (5 to 10 years) to overcome the Sahel's dependency on rainfall when only 1-5 percent of the arable land in the region is presently under irrigation; (2) there is not a proven biologically stable and economically profitable package to step up food grain production--millet and sorghum--in any of the eight Sahelian countries; (3) action programs--seed multiplication, credit, animal traction, and extension--are generally running ahead of the research base for cereal crops; (4) the severe shortage of technical and administrative manpower cannot be solved in anything less than 25 years; and (5) factor price distortions are widespread--distortions which underprice food for the benefit of urban consumers. In short, there is no "Green Revolution" on the horizon for food crops in the next 5 to 10 years in the Sahel.

Assessment

Both CILSS and the Club du Sahel are to be applauded in laying out a long-term development strategy for 20 to 25 years. To date, the emphasis has been on improving smallholder rainfed farming in the 1980s and a gradual increase in land under irrigation. In several countries, a few agricultural and rural development projects are producing encouraging results and should be replicated. But there are a number of questions about the food-first strategy, the extractive pricing policies of national governments, grain boards (CILSS/Club du Sahel, 1979), and the proposed grain storage program for the Sahel (FAO, 1981). As a political slogan, a "food first" strategy has been effective in mobilizing support from donors for recovery projects. But there is a danger that CILSS and member governments are promoting crash food crop and extension programs before extension agents have a biologically sound and financially profitable food package ready to extend in rainfed farming areas. Since returns per hour of labor are generally substantially higher in cash crops and off-farm employment than food crops throughout West Africa, there is a need for Sahelian countries to shift to a more balanced food/cash crop strategy, taking into account variation in resource endowments by country, opportunities for intra-regional trade, etc. The 1974-81 recovery phase to date should be most appropriately called a "pilot phase." It is too soon to evaluate whether the strategies for the long-term recovery and development of the Sahelian region will be effective.

IX. SYNTHESIS AND IMPLICATIONS FOR RESEARCH AND DEVELOPMENT STRATEGIES IN THE 1980s

This survey reports and evaluates research on the economics of food, agriculture, rural nonfarm activities, agricultural policy, employment, and income distribution in 41 countries in sub-Saharan Africa. Although we have reviewed papers and publications by researchers in a wide range of disciplines, the core of this survey consists of literature produced by agricultural economists and economists. We examine research on agricultural development during the precolonial period from 1800 to the 1880s, the colonial period from the 1880s to 1960, and the postindependence period from 1960-1981. We devote the bulk of our review to the postindependence period--1960-81--with emphasis on the 1970s.

Our survey has pointed up the shaky data base and the need to interpret official statistics with caution. For example, estimates of land under irrigation vary from 1 to 5 percent. Estimates of the size of national livestock herds are notoriously suspect because of cattle tax evasion. Even trade data must be carefully examined. For example, official data on cocoa exports from Togo include a large volume of cocoa from Ghana which is smuggled into Togo (Bovet and Unnevehr, 1981). Data on rural income distribution are available for only a few countries. The combination of underdeveloped data and the case study nature of much of the research cited in our references makes it difficult to generalize about the sources of agricultural output and the causes of poverty, malnutrition, and lagging food production. We have also highlighted some of the pitfalls in presenting the results of survey research, e.g., farm management and nutrition surveys, in terms of averages. For example, data showing that farmers produce enough food to feed each family member an average of 2,000 calories a day during a given year are meaningless if some families do not have enough food to survive during the "hungry season." Moreover, the use of averages promotes the view that there is a homogenous or classless rural society and that interventions designed to improve the average incomes in an area will automatically improve the incomes of all people, including those on the lower end of the income scale. But Polly Hill and other researchers have shown that rural inequality is an integral part of Africa's history, that uneven development will usually accompany programs of planned change and that special programs are needed to reach the rural poor. Research is needed on rural income distribution, including an identification of the rural poor and an analysis of the institutional reforms which are needed to increase the access of the poor to resources, to off-farm employment opportunities, and to markets. Nutrition researchers need to generate micro data on food consumption intake by age and sex, by geographical region, and by season of the year.

Our survey has also documented the trendy nature of research on food and agriculture over the past 25 years. Research in the sixties focused on agricultural planning, and agricultural sector analysis because these topics were perceived to be complementary to the preparation of five-year development plans. But macro research faded away in the late 1960s because of the growing awareness of the need for micro studies to unravel the complexities of indigenous farming systems, the rural household as a production and consumption unit and farm-off-farm interactions. As a result research in the seventies shifted to micro studies of small farms, integrated rural development projects, small-scale industry, women in development, and appropriate technology. Migration, employment, and income distribution were also popular research topics in the 1970s because of massive rural-to-urban migration and the growing interest in equity issues. In the early 1980s, we find research focused on farming systems following the explosion of farming systems projects throughout Africa. There is also a growing interest in macro research on food policy and food security because of Africa's food crisis, the poor performance of state grain boards and food corporations, and the need for donors to ensure that food aid is contributing to national development goals.

We have documented the increase in the quantity and quality of research by economists, agricultural economists, and other social scientists over the past five years. The number of publications cited in our bibliography for the 1976-81 period is probably equal to or exceeds the research output on the economics of food and agriculture over the previous 20 year period. But much of this literature on African development is not included in development economics textbooks in universities in Africa, Western Europe, and North America because of the perception that the data base is weak in Africa and that the research output is not of high quality. Hopefully, this review will encourage scholars within and beyond Africa to tap the large and growing literature on the economics of food and agriculture in Africa.

In Part II, we pointed out the vacuity of western modernization, neoclassical dual sector models, labor and land surplus models, and stages of growth models in an agrarian-dominated continent such as sub-Saharan Africa. There were two major shortcomings of these models. One was the assumption that one discipline--economics--could provide answers on how to slay the dragons of poverty, inequality, and malnutrition in the Third World. The second shortcoming was their excessive macro orientation and their inability to explain the complexities of the agricultural sector. The shortcomings of these models spurred micro research in the 1970s. Village studies, farming systems research, and research on rural nonfarm employment are examples of how neoclassical economists tried to develop an improved understanding of African agriculture from the bottom up. The

results of these studies show that smallholders and herders can compete with large farms, plantations, and ranches. The implication is that small-scale production units--farming, fishing, livestock, and rural industries--should receive policy and research priority because they will, in most cases, be more capable of achieving efficiency and equity objectives than plantations, ranches, and large-scale industry.

The shortcomings of the western models of development to come to grips with broad social, political, and structural issues opened the door for political economy models of development and underdevelopment to emerge and gain wide support in Africa in the 1970s. Political economy scholars stress the need to understand development as a long-term historical process, to consider the linkages between national economies and the world economic system, and to address structural problems which are often overlooked by neoclassical economists. But the Achilles heel of the outward-looking political economy models will likely be the failure to provide a convincing specification of the agricultural sector which is based on micro research. For example, when one examines the writings of Samir Amin, Colin Leys, and John Saul, one finds little mention of the need for technical change, little sympathy for international migration and little concrete guidance on what steps should be taken to resolve Africa's food crisis. The challenge facing radical scholars is to move from critiques of western development economics and agrarian capitalism to developing political economy models which are empirically grounded in the villages of Africa.

We detect that there is a slow convergence of mainstream (neoclassical) and political economy (radical) schools of thought. Neoclassical economists and political economy scholars are in agreement that growth and equity issues are central to the design of strategies, policies and projects in Africa. There is a need for both groups of scholars to examine why political forces in both capitalist and socialist countries perpetuate policies which extract the agricultural surplus for the benefit of urban people and maintain an incentive structure which encourages black markets, smuggling, and international migration of both farmers and agricultural scientists. One of the major challenges of the 1980s is to develop African models of development which are based on empirical research in Africa and are relevant for agrarian-dominated and politically fragile countries with small pools of trained agricultural scientists and limited administrative capacity. These models, in our judgment, will likely form a middle ground between the neo-classical views of T. W. Schultz and Samir Amin's political economy paradigm.

The debate over agrarian capitalism and socialism has been one of the most important topics pursued by social science researchers and African politicians over the past 20 years. The empirical record in the early 1960s quickly proved that capitalism and

foreign aid could not produce miracles that would allow countries to "skip stages of growth" (a theme repeated by African politicians in the 1960s and 1970s). The failure of capitalism in the early 1960s "to bring development to the people" led to the swift replacement of capitalism with socialism in Ghana, Mali, Guinea, and Tanzania (then Tanganyika). Tanzania's shift to socialism in 1967 has been closely monitored by African politicians, scholars, and students. The Tanzanian experiment was as closely followed in Africa as China's experiment was studied throughout the world in the 1970s. But today there is overwhelming evidence that agrarian socialism is in deep trouble in Tanzania. Rene Dumont and M.-F. Mottin (1980) recently summed up Tanzania's experience by observing that President Nyerere had the European donors "eating out of his hand" in the 1970s but today "the stark reality dispels all illusion."

Agrarian socialism is now under fire throughout Africa because after 20 years of experimentation there are no countries where agrarian socialism is performing well. But as the pendulum swings between socialism, state capitalism, and free market forces, it is useful to point out that successful agricultural and rural development policies, programs, and projects can be achieved under either capitalism or socialism. To put all or most of the weight on ideology-capitalism or socialism--is to ignore an important lesson that has been learned over the past 30 years--namely, ideology of economic policy is but one variable influencing the outcome of agricultural development projects, programs, and strategies. To concentrate on ideology is to overlook a central cause of rural poverty in sub-Saharan Africa: the fact that from 60-80 percent of the labor force produces food at very low levels of productivity. For example, research has shown that "it requires 80 to 100 man-days of labor to grow a ton of maize, rice, or the grain equivalent of roots and tuber crops in West Africa" (Flinn, Jellema, and Robinson, 1975, p. 46). Moreover, research has documented the closing of the frontier in numerous countries and the need to turn from land-extensive to intensive farming in the 1980s and 1990s. By the year 2000, all but a few countries (e.g., Zaire) will have exhausted their frontier. As population pressure pushes cultivation onto areas with poor natural resources, the three-way competition for land--food production, livestock, and wildlife and forest reserves--will intensify and soil fertility will likely decline (e.g., Lagemann, 1977). These are common problems which will have to be addressed regardless of whether a government is capitalist or socialist.

One is overwhelmed by the speed at which Africa's historical position of self-sufficiency in staple foods has been dissipated in just 20 years. In a nutshell, aggregate food production in sub-Saharan Africa grew very slowly--about 1.8 percent per year in the 1960-80 period--a rate below the aggregate growth rate of Asia or Latin America. At

the same time, the annual population growth rate in Africa was 2.1 percent in the mid-1950s, 2.7 percent in the late 1970s, and is projected to increase throughout the 1980s until it levels off to about 3 percent around 1990. We have shown that agricultural stagnation has its roots in colonial policies and institutions and in the continuing neglect of agriculture by African governments--whether capitalist, socialist, military, or civilian--over the past 20 years. It is an empirical fact, for example, that per capita food production started to decline in sub-Saharan Africa in the 1960s--long before the 1968-74 drought in Sahelian West Africa, the Sudan, Ethiopia, Somalia, and Kenya, and before the Uganda/Tanzanian and the Ethiopian/Somalian wars of the late 1970s (USDA, 1981). Yields of most food and export crops are lower in sub-Saharan Africa than in other continents. For example, cocoa yields in Africa are less than half of those in parts of Asia while oil palm yields are only about half those in Indonesia and Malaysia. The technical breakthroughs in African agriculture are few and far between and the rate of return on investment in food crops is low using known technology throughout rainfed areas stretching from Mauritania to Upper Volta, the Sudan, Somalia, and parts of Tanzania. Our survey has shown that there is a need for greatly increased expenditures to strengthen research on rainfed and irrigated farming in national agricultural research services in Africa over the next 20-30 years.

In livestock, the technical coefficients are also unfavorable; the rate of weight gain of cattle is low, animals lose weight during the long dry season, calf losses are high, off-take rates are low, and disease is a major problem. The presence of tsetse flies and the resulting disease, trypanosomiasis, preclude the use of a vast area of fertile and higher rainfall land--an area which covers one-fourth to one-third of the arable land in sub-Saharan Africa. Both technical and economic research on livestock should be greatly expanded in the 1980s in order to supplement the large number of ethnographic studies of livestock systems by anthropologists. Research on small ruminants should be greatly expanded.

Our survey has convinced us that social scientists should shift more of their attention from ex post studies of the economic and social effects of technical change to working with technical scientists on constraints on food, cash crop, and, livestock production and research on soil fertility, soil conservation, land use planning, reforestration, and alternative sources of energy for cooking. Research on these topics in the 1980s and 1990s will hopefully produce some results to help the next generation.

Finally, whereas the research pendulum shifted to micro studies in the 1970s, there is now a need to step up macro-economic research with emphasis on food policy issues. But research on food policy must be pursued within a broader framework than food

self-sufficiency. The central question is what are the economic and political costs of achieving a set of objectives of which food security is but one of many objectives. Unfortunately, many of the steps to meet Africa's food crisis will be holding actions--steps to alleviate a deteriorating situation. Examples include holding people in low rainfall areas until more land is brought under irrigation and higher rainfall areas can be cleared of tsetse flies and river blindness. This is the price that many countries will have to pay for neglecting agriculture over the past two decades.

There are no five to ten year solutions to Africa's problems of poverty, malnutrition, and lagging food production. There is a need to jettison the development rhetoric of the moment--e.g., food first, food self-sufficiency, appropriate technology, intermediate technology, basic needs--and concentrate over the next 20-30 years on what we call the fundamentals of agricultural development: structural reforms, training of African scientists, the strengthening of faculties of agriculture and national agricultural extension and research systems, and improving policy analysis and the administration and execution of development programs and projects (see Eicher, 1982).

BIBLIOGRAPHIES AND LITERATURE REVIEWS BY SUBJECT AREA AND REGION

African Studies Since 1945	Fyfe (1976)
Botswana	S. F. Eicher (1981)
Community Development	Holdcroft (1978)
Credit and Finance	Miller (1977)
Desertification	Paylore (1976); Paylore and Mabbutt (1980)
East Africa	Killick (1976)
Farming Systems	Norman (1979); Lawani, Alluri, and Adimorah (1979); Gilbert, Norman, and Winch (1980); Ruthenberg (1980)
Fertilizer	Zalla, Diamond, and Mudahar (1977); Mudahar (1980)
Food Consumption	FAO (1974, 1981c)
French-Speaking Africa	Bibliographie des Travaux--CARDAN (1979)
The Gambia	Gamble (1979)
Goats	Sands and McDowell (1979)
Income Distribution	Jain (1975); Rweyemamu (1980)
Irrigation	DesBouvrie and Rydzewski (1977); Sparling (1981)
Land Settlement	FAO (1976b); Higgs (1978)
Land Tenure	T. J. Anderson (1976); Adegboye (1977); J. M. Cohen (1980)
Livestock	Dahl and Hjort (1979); Ergas (1979)
Marketing	CILSS/Club du Sahel (1977); Riley and Weber (1979)
Marketing Boards	Aladejana (1970); Blanford (1979)
Mechanization	Kline et al. (1969); Gemmill and Eicher (1973); Gaury (1977); Sargent et al. (1981)
Migration	Byerlee (1972); Yap (1977); Todaro (1980)
Rainfed Farming	Ouedraogo, Newman, and Norman (In Press)
Root Crops	Terry, Oduro, and Caveness (1981)

REFERENCES

Abalu, G. O. I. (1974). "Supply Response to Producer Prices: A Case Study of Groundnut Supply in Northern Nigeria." Nigerian J. Econ. Soc. Studies 16:419-427.

_____. (1975). "Optimal Investment Decisions in Perennial Crop Production: A Dynamic Linear Approach." J. Agr. Econ. 26:383-393.

_____. (1976). "A Note on Crop Mixtures Under Indigenous Conditions in Northern Nigeria." J. Development Studies 12:213-220.

_____. (1980). "Farm Level Surveys of West African Agriculture: A Critique of Conventional Methodology" in Purdue, 1980.

Abalu, G. O. I., and B. D'Silva. (1980a). "Socioeconomic Analysis of Existing Farming Systems and Practices in Northern Nigeria" in ICRISAT, 1980a, pp. 3-10.

_____. (1980b). "Nigeria's Food Situation: Problems and Prospects." Food Policy 5(1):49-60.

Abercrombie, K. C. (1961). "The Transition From Subsistence to Market Agriculture in Africa South of the Sahara." Monthly Bulletin Agr. Econ. and Stat. 10(2):1-7. (Reprinted in Whetham and Currie, 1967, 1-11.)

Aboyade, O. (1973). Incomes Profile. An Inaugural Lecture delivered at the University of Ibadan, Nigeria. Ibadan, Nigeria, Univ. of Ibadan Bookshop.

Acland, J. D. (1971). East African Crops: An Introduction to the Production of Field and Plantation Crops in Kenya, Tanzania and Uganda. London, Longmans.

Adams, A. (1977a). Le long voyage des gens du fleuve. Paris, Maspero.

_____. (1977b). "The Senegal River Valley: What Kind of Change?" Rev. Afr. Polit. Econ. 10:33-60. (Reprinted in Heyer, Roberts, and Williams, 1981, pp. 325-353.)

Adams, D. W. (1978). "Mobilizing Household Savings Through Rural Financial Markets." Econ. Dev. and Cultural Change 26(3):547-560.

Adams, D. W., and D. H. Graham. (1981). "A Critique of Traditional Agricultural Credit Projects and Policies." J. Dev. Econ. 8:347-366.

Adams, J. M., and G. W. Harman. (1977). The Evaluation of Losses in Maize Stored on a Selection of Small Farms in Zambia with Particular Reference to the Development of Methodology. London, Tropical Products Institute.

Adams, M. E., and J. Howell. (1979). "Developing the Traditional Sector in the Sudan." Econ. Dev. and Cultural Change 27(3):505-518.

Adegboye, R. O. (1969). "Procuring Loans Through Pledging of Cocoa Trees." J. Geographical Assoc. of Nigeria 12(1/2).

_____. (1977). "Land Tenure" in Leakey and Wills, 1977, pp. 313-327.

Adegeye, A. J. (1976). "Producer Prices, Farmers' Responses and Productivity Interactions: Some Relevant Issues." J. Rural Econ. and Development (Ibadan) 10(2):20-27.

Ady, P. (1968). "Supply Functions in Tropical Agriculture." Oxford Bulletin Econ. and Stat. 30:157-188.

Agboola, S. A. (1968). "The Introduction and Spread of Cassava in Western Nigeria." Nigerian J. Econ. Soc. Studies 10(3):369-385.

Agiri, B. (1977). "The Introduction of Nitida Kola Into Nigerian Agriculture, 1880-1920." African Econ. History 3:1-14.

Ahmed, A. G. M. (1979). "The Relevance of Contemporary Anthropology" in Huizer and Mannheim, 1979, pp. 171-185.

Ahn, P. M. (1969). West African Agriculture. Vol. I: West African Soils. London, Oxford Univ. Press.

_____. (1977). "Soil Factors Affecting Rainfed Agriculture in Semi-Arid Regions with Particular Reference to the Sahel Zone of Africa" in Cannell, 1977, pp. 128-165.

AID. (1976). Proposal for a Long-Term Comprehensive Development Program for the Sahel: Report to the U.S. Congress. Part I. Major Findings and Programs: Part II, Technical Background Papers. Washington.

_____. (1978). Toward a Rational U.S. Policy on River Basin Development in the Sahel: Proceedings of a Colloquium. Washington.

_____. (1980). Workshop on Pastoralism and African Livestock Development. Washington, Bureau for Program and Policy Coordination, AID Program Evaluation Report No. 4.

Ake, C. (1981). A Political Economy of Africa. London, Longmans.

Akinwumi, J. A., and A. J. Adegeye. (1977). "Prospects and Problems of a Common Agricultural Policy Among the West African States" in Dams and Hunt, 1977, pp. 396-418.

Aklilu, B. (1980). "The Diffusion of Fertilizer in Ethiopia: Pattern, Determinants, and Implications." J. Dev. Areas 14:387-399.

Aladejana, A. (1970). The Marketing Board System: A Bibliography. Ibadan, Nigeria, NISER.

Alberici, A., and M. Baravelli. (1973). Savings Banks and Savings Facilities in African Countries. Milan, Italy, Cassa di Risparmio delle Provincie Lombarde.

Aldington, T. (1971). Producer Incentives as a Means of Promoting Agricultural Development: A Case Study of Cotton in Kenya. Nairobi, Univ. of Nairobi, IDS, Discussion Paper No. 105.

Aldington, T. J., and F. A. Wilson. (1968). The Marketing of Beef in Kenya. Nairobi, Univ. of Nairobi, IDS, Occasional Paper No. 3.

Alibaruho, G. (1974). "Regional Supply Elasticities in Uganda's Cotton Industry and the Declining Level of Cotton Output." Eastern Africa Econ. Rev. 6(2):35-56.

Allan, W. (1965). The African Husbandman. Edinburgh, Oliver and Boyd.

Alverson, H. (1979). "Arable Agriculture in Botswana: Some Contributions of the Traditional Social Formation." Rural Africana, New Series, 4-5:33-48.

Amann, V. F., ed. (1973). Agricultural Policy Issues in East Africa. Proceedings of the East African Agricultural Economics Society Conference, Nairobi, June 1971. Kampala, Uganda, Makerere Univ. Printery.

Amie, L., and J. G. Disney. (1973). "Quality Changes in West African Marine Fish During Iced Storage." Tropical Science 15(2):125-38.

Amin, S. (1965). Trois experiences Africaines de developpement: le Mali, la Guinee et le Ghana. Paris, Presses Universitaires de France.

_____. (1967). Le developpement du capitalisme en Cote d'Ivoire. Paris, Editions de Minuit.

_____. (1970). "Development and Structural Change: The African Experience, 1950-70." J. International Affairs 24:203-223.

_____. (1972). "Underdevelopment and Dependence in Black Africa--Origins and Contemporary Forms." J. Modern African Studies 10:503-524.

_____. (1973). "Transitional Phases in Sub-Saharan Africa." Monthly Review 25(5):52-57.

_____., ed. (1974a). Modern Migrations in Western Africa. London, Oxford Univ. Press for International African Institute.

_____. (1974b). "Introduction" in Amin, 1974a, pp. 3-124.

_____. (1974c). Accumulation on a World Scale: A Critique of the Theory of Underdevelopment. New York, Monthly Review Press.

_____. (1976). Unequal Development: An Essay on the Social Formations of Peripheral Capitalism. New York, Monthly Review Press. (Translation of Le developpement inegal, Paris, Les Editions de Minuit, 1973.)

Amin, S.; C. Atta-Mills; A. Bujra; G. Hamid; and T. Mkandawire. (1978). "Social Sciences and the Development Crisis in Africa, Problems and Prospects." Africa Development 3(4):23-45.

Amin, S., and F. Okediji. (1974). "Land Use, Agriculture and Food Supply, and Industrialization--Introduction" in Cantrelle, 1974, pp. 409-423.

Amon, B. O. E., and S. A. Adetunji. (1973). "The Response of Maize, Yams and Cassava to Fertilizers in a Rotation Experiment in the Savannah Zone of Western Nigeria." Nigerian Agr. J. 10(1):91-105.

Amselle, J.-L., ed. (1976). Les Migrations Africaines: Reseaux et Processus Migratoires. Paris, Maspero.

Ancey, G. (1974). Relations de voisinage ville-campagne. Une analyse appliquee a Bouake: sa couronne et sa region (Cote d'Ivoire). Paris, ORSTOM, Memoires ORSTOM No. 70.

_____. (1975). Niveaux de decision et functions objectif en milieu Africain. Paris, INSEE, AMIRA Note de Travail No. 3.

_____. (1977). "Recensement et description des principaux systemes ruraux Sahel-iens." Cah. ORSTOM, ser. sci. hum. 14(1):3-18.

Ancey, G.; J. Michotte; and J. Chevassu. (1974). L'Economie de l'espace rural de la region de Bouake. Paris, ORSTOM, Travaux et Documents de l'ORSTOM No. 38.

Anderson, D. (1975). Fluctuations of Maize and Groundnut Yields in the Lilongwe Land Development Program. Washington, World Bank, Studies in Employment and Rural Development No. 28.

Anderson, D., and M. W. Leiserson. (1980). "Rural Nonfarm Employment in Developing Countries." Econ. Dev. and Cultural Change 28(2):227-248.

Anderson, T. J., ed. (1976). Land Tenure and Agrarian Reform in Africa and the Near East: An Annotated Bibliography. Boston, G. K. Hall.

Andreou, P. (1981). "Agricultural Development Effort in Nigeria--An Economic Appraisal of the Western State Settlement Scheme." Agricultural Systems 7(1):11-20.

Andrews, D. J. (1972). "Intercropping with Sorghum in Nigeria." Experimental Agriculture 8:139-150.

_____. (1974). "Responses of Sorghum Varieties to Intercropping." Experimental Agriculture 10(1):57-63.

_____. (1975). "Sorghum Varieties for the Late Season in Nigeria." Tropical Agriculture 52(1):21-30.

Annegers, J. F. (1973). "Seasonal Food Shortages in West Africa." Ecology of Food and Nutrition 2:251-257.

Anschel, K. R.; R. H. Brannon; and E. D. Smith, eds. (1969). Agricultural Cooperatives and Markets in Developing Countries. New York, Praeger.

Ansell, A., and M. Upton. (1979). Small Scale Water Storage and Irrigation: An Economic Assessment for South West Nigeria. Reading, U.K., Univ. of Reading, Dept. of Agr. Econ. and Mgt.

Anthonio, Q. B. O. (1968). "The Marketing of Staple Foodstuffs in Nigeria: A Study in Pricing Efficiency." Ph.D. dissertation, Univ. of London.

Anthony, K. R. M.; B. F. Johnston; W. O. Jones; and V. C. Uchendu. (1979). Agricultural Change in Tropical Africa. Ithaca, Cornell Univ. Press.

Anthony, K. R. M., and V. C. Uchendu. (1970). "Agricultural Change in Mazabuka District, Zambia." Food Research Institute Studies 9(3):215-266.

_____. (1974). Agricultural Change in Geita District, Tanzania. Nairobi, East African Literature Bureau.

Apthorpe, R. (1972). Rural Cooperatives and Planned Change in Africa: An Analytical Overview. Geneva, UN Research Institute for Social Development.

Arditi, C. (1975). Les Circuits de Commercialisation des Produits du Secteur Primaire en Afrique de l'Ouest, Analyse Bibliographique. Paris, Ministere de la Cooperation, Service des Etudes Economiques et de la Planification.

Are, L. A., ed. (1975). Socio-Economic Aspects of Rice Cultivation. Monrovia, Liberia, WARDA, Seminar Proceedings 3.

Ariza-Nino, E., and C. Steedman, eds. (1979, 1980). Livestock and Meat Marketing in West Africa. 5 vols. Ann Arbor, Univ. of Michigan, CRED.

Arnold, M., ed. (1976). Agricultural Research for Development: The Namulonge Contribution (Uganda). Cambridge, Cambridge Univ. Press.

Arrighi, G. (1970). "Labour Supplies in Historical Perspective: A Study of the Proletarianization of the African Peasantry in Rhodesia." J. Development Studies 6(3):197-234. Reprinted in Arrighi and Saul, 1973, pp. 180-234.

Arrighi, G., and J. S. Saul. (1968). "Socialism and Economic Development in Tropical Africa." J. Modern African Studies 6(2):141-169. Reprinted in Arrighi and Saul, 1973, pp. 11-43.

_____. (1973). Essays on the Political Economy of Africa. New York, Monthly Review Press.

Arrivets, J. (1976). "Exigences minerales du sorgho--etude d'une variete voltaique a grand tige." L'Agronomie Tropicale 31(1):29-46.

Ascroft, J.; F. Chege; J. Kariuki; N. Roling; and G. Ruigu. (1972). "Does Extension Create Poverty in Kenya?" East Africa J. 9(3):28-33.

Ascroft, J.; N. Roling; J. Kariuki; and F. Chege. (1973). Extension and the Forgotten Farmer: First Report of a Field Experiment. Wageningen, Afdelingen voor sociale wetenschappen aan de landbouwhogeschool.

Askari, H., and J. Cummings. (1976). Agricultural Supply Response: A Survey of the Econometric Evidence. New York, Praeger.

Atayi, E. A., and H. C. Knipscheer. (1980). Survey of Food Crop Farming Systems in the "ZAPI-EST" East Cameroon. Ibadan, Nigeria, IITA/ONAREST.

Atta-Konadu, Y. K. (1974). "Economic Optima in Resource Allocation for Smallholder Subsistence Farming in Ghana." Unpublished Ph.D. dissertation, Michigan State Univ.

Atsu, S. Y. (1974). The Focus and Concentrate Programme in the Kpandu and Ho Districts; Evaluation of an Agricultural Extension Programme. Legon, Univ. of Ghana, ISSER, Tech. Pub. Ser. No. 34.

Awogbade, M. O. (1979). "Fulani Pastoralism and the Problems of the Nigerian Veterinary Service." African Affairs 78:493-506.

Ayuko, L. (1980). Ranch Organizational Structures. Summary of Papers presented at an ILCA Conference in Addis Ababa, 25-29 February 1980. Addis Ababa, ILCA, ILCA Bulletin No. 9.

_____. (1981). Organization, Structures and Ranches in Kenya. London, Overseas Development Institute, Pastoral Network Paper No. 11b.

Bachmann, E., and F. E. Winch. (1979). Yam Based Farming Systems in the Humid Tropics of Southern Nigeria. Ibadan, Nigeria, IITA.

Baier, S. B. (1976). "Economic History and Development: Drought and the Sahelian Economies of Niger." African Econ. History 1:1-16.

_____. (1977). "Trans-Saharan Trade and the Sahel: Damergu, 1870-1930." J. African History 18:37-60.

_____. (1980). An Economic History of Central Niger. Oxford, Clarendon Press.

Baier, S. B., and D. J. King. (1974). "Drought and the Development of Sahelian Economies: A Case Study of the Hausa and Tuareg." Land Tenure Center Newsletter 54.

Baker, D. (1981). "Impact on Rural Inequality of Promoting Rural Non-Farm Activities: Evidence from Sierra Leone." Paper presented at the 1981 AAEA Meetings, Clemson University, July 26-29, 1981.

Baker, E. F. I. (1978-1980). "Mixed Cropping in Northern Nigeria. I-IV." Experimental Agr. 14(4):293-298; 15(1):33-40; 15(1):41-48; 16(4):361-370.

Baldwin, K. D. S. (1957). The Niger Agricultural Project: An Experiment in African Development. Cambridge, Harvard Univ. Press.

Baldwin, R. E. (1956). "Patterns of Development in Newly Settled Regions." Manchester School of Econ. Soc. Studies 24:161-179. (Reprinted in Eicher and Witt, 1964, pp. 238-251.)

_____. (1966). Economic Development and Export Growth: A Study of Northern Rhodesia, 1920-1960. Berkeley, Univ. of California Press.

Bannerjee, B., and S. M. Kanbur. (1981). "On the Specification and Estimation of Macro Rural-Urban Migration Functions with an Application to Indian Data." Oxford Bulletin Econ. and Stat. 43(1):7-30.

Baran, P. A. (1952). "On the Political Economy of Backwardness." Manchester School of Econ. Soc. Studies 20:66-84.

Barker, J. S. (1979). "The Debate on Rural Socialism in Tanzania" in Mwansasu and Pratt, 1979, pp. 95-124.

Barnes, C. (1979). "An Experiment With Coffee Production by Kenyans, 1933-1948." African Econ. History 8:198-209.

Barnes, C. T. (1976). "Problems of Transformation--Marine Fisheries in Tanzania." Eastern Africa J. Rural Development 9(1-2):168-199.

Barnett, T. (1977). The Gezira Scheme: An Illusion of Development. London, Cass.

_____. (1979). "Why Are Bureaucrats Slow Adopters? The Case of Water Management in the Gezira Scheme." Sociologia Ruralis 19(1):60-70.

_____. (1981). "Evaluating the Gezira Scheme: Black Box or Pandora's Box" in Heyer, Roberts, and Williams, pp. 306-324.

Barnum, H. D., and R. H. Sabot. (1976). Migration, Education and Urban Surplus Labour: The Case of Tanzania. Paris, OECD, Development Center.

Barrett, V.; G. Lassiter; D. Wilcock; D. Baker; and E. Crawford. (1982). Animal Traction in Eastern Upper Volta: A Technical, Economic and Institutional Analysis. East Lansing, Michigan State Univ., Dept. of Agric. Econ., MSU International Development Paper No. 4.

Barwell, C. (1975). Farmer Training in East-Central and Southern Africa. Rome, FAO.

Bateman, M. J. (1965). "Aggregate and Regional Supply Functions for Ghanaian Cocoa, 1946-1962." J. Farm Econ. 47(2):384-401.

Bates, D. G., and S. H. Lees. (1977). "The Role of Exchange in Productive Specialization." Amer. Anthropologist 79(4):824-841.

Bates, R. H. (1976). Rural Responses to Industrialization: A Study of Village Zambia. New Haven, Yale Univ. Press.

_____. (1981). States and Markets in Tropical Africa: The Political Basis of Agricultural Policies. Berkeley and Los Angeles, Univ. of California Press.

Bates, R. H., and M. F. Lofchie, eds. (1980). Agricultural Development in Africa: Issues of Public Policy. New York, Praeger.

Bauer, P. T. (1954). West African Trade: A Study of Competition, Oligopoly and Monopoly in a Changing Economy. London, Cambridge Univ. Press, reprinted with a new preface by Routledge and Kegan Paul, London, 1963.

_____. (1975). "British Colonial Africa: Economic Retrospect and Aftermath" in Duigan and Gann, 1975, pp. 632-654.

Bauer, P. T., and B. S. Yamey. (1959). "A Case Study of Response to Price in an Underdeveloped Country." Econ. J. 69:800-805.

Baumann, H. (1928). "The Division of Work According to Sex in African Hoe Culture." Africa 1(3):289-319.

Beals, R. E., and C. F. Menezes. (1970). "Migrant Labour and Agricultural Output in Ghana." Oxford Econ. Papers 21(1):109-127.

Becker, J. A. (1974). An Analysis and Forecast of Cereals Availability in the Sahelian Entente States of West Africa. Washington, USAID, Final Report No. AID/CM/AF1-C-73-20.

Beckford, G. (1972). "Strategies for Agricultural Development: Comment." Food Research Institute Studies 11(2):149-154.

Beckman, B. (1976). Organizing the Farmers: Cocoa Politics and National Development in Ghana. New York, Holmes and Meier.

Beeden, P.; D. W. Norman; W. J. Kroeker; D. H. Pryor; H. M. Hays; and B. Huizinga. (1976). The Feasibility of Improved Sole Crop Cotton Production Technology for the Small-Scale Farmer in the Northern Guinea Savanna Zone of Nigeria. Zaria, Nigeria, Ahmadu Bello Univ., IAR, Samaru Miscellaneous Paper 60.

Behrman, J. R. (1968). "Monopolistic Cocoa Prices." Amer. J. Agr. Econ. 50(3):702-719.

Bell, C. L. G., and D. B. R. Hazell. (1980). "Measuring the Indirect Effects of an Agricultural Investment Project on Its Surrounding Region." Amer. J. Agr. Econ. 62(1):75-86.

Bellioncle, G. (1974). Etude sur le credit agricole dans trois villages de la region de Maradi (Niger). Rome, FAO, Agricultural Credit Case Studies, Working Paper No. 5.

Belshaw, D. G. R. (1968). "Agricultural Extension, Education and Research" in Helleiner, 1968b, pp. 57-78.

_____. (1979). "Taking Indigenous Technology Seriously: The Case of Inter-Cropping in East Africa." IDS, Sussex, Bulletin 10:24-27. Reprinted in Brokensha, Warren, and Werner, 1980, pp. 197-203.

Belshaw, D. G. R., and M. Hall. (1972). "The Analysis and Use of Agricultural Experimental Data in Tropical Africa." Eastern Africa J. Rural Development 5:39-72.

Benneh, G. (1972). "Systems of Agriculture in Tropical Africa." Econ. Geography 48(3):244-257.

Benoit-Cattin, M. (1977a). "Analyse economique pluriannuelle d'un groupe de carres suivis. Unites experimentales du Senegal--1969-1975--Methodes et principaux resultats." L'Agronomie Tropicale 32-4:413-426.

_____. (1977b). Project terres neuves II. Rapport sur la suivi agro-socioeconomique de la campagne, 1976-77. Bambey, Senegal, CNRA.

_____. (1980). "Approache socio-economique des exploitations agricoles" in ICRISAT, 1980a, pp. 410-414.

Benor, D., and J. Q. Harrison. (1977). Agricultural Extension: The Training and Visit System. Washington, World Bank.

Berg, A. (1981). Malnourished People: A Policy Review. Washington, World Bank.

Berg, E. (1961). "Backward-Sloping Labor Supply Functions in Dual Economies: The Africa Case." Quart. J. Econ. 75:468-492.

_____. (1964). "Socialism and Economic Development in Tropical Africa." Quart. J. Econ. 78:549-573.

_____. (1965). "The Economics of the Migrant Labor System" in Kuper, pp. 160-181.

_____. (1980). "Reforming Grain Marketing Systems in West Africa: A Case Study of Mali" in ICRISAT, 1980a, pp. 147-172.

Bernard, H. R., and P. J. Pelto, eds. (1972). Technology and Social Change. New York, Macmillan.

Bernstein, H. (1979). "African Peasantries: A Theoretical Framework." J. Peasant Studies 6(4):421-443.

Bernus, E. (1974a). "L'evolution recente des relations entre eleveurs et agriculteurs en Afrique tropicale: l'exemple du Sahel Nigerien." Cahiers ORSTOM, Ser. Sci. Hum. 11(2):137-145.

Bernus, E., and G. Savonnet. (1973). "Les problemes de la secheresse dans l' Afrique de l' Quest." Presence Africaine 88:112-138.

Berry, S. S. (1975). Cocoa, Custom and Socio-Economic Change in Rural Western Nigeria. Oxford, Clarendon Press.

_____. (1976). "Supply Response Reconsidered: Cocoa in Western Nigeria, 1909-44." J. Development Studies 13(1):4-17.

_____. (1980). "Rural Class Formation in West Africa" in Bates and Lofchie, 1980, pp. 401-424.

Beye, G. (1977). "Etude de l'action de doses croissantes d'azote en presence ou en absence de paille de riz enfouie sur le developpement et les rendements de riz en Basse-Casamance." L'Agronomie Tropicale 32(1):41-50.

Bhaduri, A. (1977). "On the Formation of Usurious Interest Rates in Backward Agriculture." Cambridge J. Econ. 1(4):341-352.

Bibliographie des travaux en langue Francaise sur l'Afrique au sud du Sahara sciences humaines et sociales. (1979). Paris, EHESS, CEA-CARDAN.

Biebuyck, D., ed. (1963). African Agrarian Systems. London, Oxford Univ. Press.

Bienen, H., and V. P. Diejomaoh, eds. (1981). The Political Economy of Income Distribution in Nigeria. New York, Holmes and Meier.

Bigot, Y. (1977). "Fertilisation, labour et espece cultivee en situation de pluviosite incertaine de centre de Cote-d'Ivoire--Synthese des principaux resultats d'un test de differentes systemes culturaux 1967 a 1974." L'Agronomie Tropicale 32(3):242-247.

Binswanger, H. (1978). The Economics of Tractors in South Asia, An Analytical Review. New York and Hyderabad, India, ADC and ICRISAT.

Binswanger, H. P.; R. D. Ghodake; and G. E. Thierstein. (1980). "Observations on the Economics of Tractors, Bullocks and Wheeled Tool Carriers in the Semi-Arid Tropics of India" in ICRISAT, 1980a, pp. 199-211.

Blackie, M. J. (1981). A Time to Listen: A Perspective on Agricultural Policy in Zimbabwe. Salisbury, Univ. of Zimbabwe, Dept. of Land Management, Working Paper 5/81.

Blandford, D. (1973). "Some Estimates of Supply Elasticities for Nigeria's Cash Crops. A Comment." J. Agr. Econ. 24(3):601-604.

_____. (1979). "West African Export Marketing Boards" in Agricultural Marketing Boards--An International Perspective, S. Hoos, ed. Cambridge, Ballinger, pp. 121-150.

Blitzer, C. R. (1979). "Development and Income Distribution in a Dual Economy: A Dynamic Simulation Model for Zambia." J. Development Economics 6(3):407-429.

Blomquist, A. G. (1978). "Urban Job Creation and Unemployment in LDCs: Todaro vs. Harris and Todaro." J. Development Economics 5:3-18.

Boeke, J. H. (1953). Economics and Public Policy as Exemplified by Indonesia. New York, Institute of Pacific Relations.

Boesen, J., and A. T. Mohele. (1979). The "Success" Story of Peasant Tobacco Production in Tanzania: The Political Economy of a Commodity Producing Peasantry. Uppsala, Scandinavian Institute of African Studies.

Bohannan, P. (1963). "Land, 'Tenure', and Land Tenure" in Biebuyck, pp. 101-115.

Bohannan, P., and G. Dalton, eds. (1962). Markets in Africa. Evanston, Illinois, Northwestern Univ. Press.

Booth, R. H. (1974). "Post-Harvest Deterioration of Tropical Root Crops: Losses and Their Control." Tropical Science 16(2):49-63.

Boserup, E. (1965). The Conditions of Agricultural Growth: The Economics of Agrarian Change Under Population Pressure. London, Allen and Unwin.

_____. (1970). Woman's Role in Economic Development. New York, St. Martins Press.

_____. (1980a). "The Position of Women in Economic Production and in the Household, with Special Reference to Africa" in The Household, Women and Agricultural Development, C. Presvelan and S. Spijkers-Zwart, eds. Wageningen, H. Veenman and Zonen B.V., pp. 11-16.

_____. (1980b). "Food Production and the Household as Related to Rural Development" in The Household, Women and Agricultural Development, C. Presvelan and S. Spijkers-Zwart, eds. Wageningen, H. Veenman and Zonen B.V., pp. 35-40.

_____. (1981). Population and Technological Change: A Study of Long-Term Trends. Chicago, Univ. of Chicago Press.

Botswana, Government of. (1975). National Policy on Tribal Grazing Land. Gaborone, Govt. Printer, Government Paper No. 2 of 1975.

_____. (1976). The Rural Income Distribution Survey in Botswana, 1974/75. Gaborone, Govt. Printer.

Bottomley, A. (1963). "The Premium for Risk as a Determinant of Interest Rates in Underdeveloped Rural Areas." Quart. J. Econ. 77(4):637-647.

_____. (1975). "Interest Rate Determination in Underdeveloped Rural Areas." Amer. J. Agr. Econ. 57(2):279-291.

Bottrall, A. (1981). Comparative Study of the Management and Organization of Irrigation Projects. Washington, World Bank, Staff Working Paper No. 458.

Boulet, J. (1975). Magoumaz: pays Mafa (Nord Cameroun) (etude d'un terroir de montagne). Paris, Mouton and ORSTOM, Atlas des structures agraires au sud du Sahara 11.

Boutillier, J.-L. (1980). "Irrigated Farming in the Senegal River Valey" in Purdue Univ., 1980.

Boutillier, J.-L.; P. Cantrelle; J. Causse; C. Laurent; and Th. N'Doye. (1962). La moyenne vallee du Senegal; Etude socio-economique. Paris, Republique Francaise, Ministere de la Cooperation et INSEE.

Bovet, D., and L. Unnevehr. (1981). Agricultural Pricing in Togo. Washington, World Bank, Staff Working Paper No. 467.

Boyce, J. K., and R. E. Evenson. (1975). National and International Research and Extension Programs. New York, ADC.

Brandt, H. (1979). Peasant Work Capacity and Agricultural Development. Berlin, German Development Institute, Occasional Paper No. 55.

Bratton, M. (1977). "Structural Transformation in Zimbabwe: Comparative Notes From the Neo-Colonisation of Kenya." J. Modern African Studies 15:591-611.

_____. (1981). "Development in Zimbabwe: Strategy and Tactics." J. Modern African Studies 19(3).

Breman, H., and A. M. Cisse. (1977). "Dynamics of Sahelian Pastures in Relation to Drought and Grazing." Oecologia 28(4):301-315.

Brett, E. A. (1973). Colonialism and Underdevelopment in East Africa: The Politics of Economic Change, 1919-1939. London, Heinmann.

Brinckman, W. L., and P. N. De Leeuw. (1979). "The Nutritive Value of Browse and Its Importance in Traditional Pastoralism" in Wildlife Management in Savannah Woodland: Recent Progress in African Studies, S. S. Ajayi and L. B. Halstead, eds. London, Taylor and Frances, pp. 101-122.

Brokensha, D. W.; D. M. Warren; and O. Werner, eds. (1980). Indigenous Knowledge Systems and Development. Landham, Maryland, Univ. Press of America.

Bromberger, N. (1979). Mining Unemployment in South Africa--1946-2000. Geneva, ILO, World Employment Program Working Paper WEP 2-26/WP38.

Bromley, D. W.; D. C. Taylor; and D. E. Parker. (1980). "Water Reform and Economic Development: Institutional Aspects of Water Management in Developing Countries." Econ. Dev. and Cultural Change 28(2):365-387.

Brooks, G. E. (1975). "Peanuts and Colonialism: Consequences of the Commercialization of Peanuts in West Africa, 1830-70." J. African History 16:29-54.

Brooks, R. M.; M. C. Latham; and W. T. Crompton. (1979). "The Relationship of Nutrition and Health to Worker Productivity in Kenya." The East African Medical J. 56(9):413-421.

Brown, B. (1980). Women, Migrant Labor and Social Change in Botswana. Boston, Boston Univ., African Studies Center, Working Paper No. 41.

Brown, C. K. (1972). Some Problems of Investment and Innovation Confronting the Ghanian Food Crop Farmer. Legon, Univ. of Ghana, ISSER, Technical Publication No. 24.

Brown, C. P. (1970). "The Malawi Farmers Marketing Board." Eastern Africa Econ. Rev. 2:37-52.

Brown, L. H. (1971). "The Biology of Pastoral Man As A Factor in Conservation." Biological Conservation 3(2):93-100.

_____. (1977). "The Ecology of Man and Domestic Livestock" in Pratt and Gwynne, pp. 34-40.

Buddenhagen, I. W., and G. J. Persley, eds. (1978). Rice in Africa: Proceedings of a Conference held at the International Institute of Tropical Agriculture, Ibadan, Nigeria, 7-11 March 1977. London and New York, Academic Press.

Bukh, J. (1979). The Village Women in Ghana. Uppsala, Scandinavian Institute for African Studies.

Bundy, C. (1979). The Rise and Fall of the South African Peasantry. Berkeley, Univ. of California Press.

Bunting, A. H., ed. (1970). Change in Agriculture. New York, Praeger.

Buvinic, M.; C. S. Adams; G. S. Edgcomb; and M. Koch-Weser. (1976). Women and Rural Development: An Annotated Bibliography. Washington, Overseas Development Council for American Association for the Advancement of Science.

Byerlee, D. (1972). Research on Migration in Africa: Past, Present and Future. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Employment Paper No. 2.

_____. (1973). Indirect Employment and Income Distribution Effects of Agricultural Development Strategies: A Simulation Approach Applied to Nigeria. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Employment Paper No. 9.

_____. (1974). "Rural-Urban Migration in Africa: Theory, Policy and Research Implications." International Migration Rev. 8:543-566.

_____. (1980). "Rural Labor Markets in West Africa with Emphasis on the Semi-Arid Tropics" in ICRISAT, 1980, pp. 348-356.

Byerlee, D., M. P. Collinson et al. (1980). Planning Technologies Appropriate to Farmers: Concepts and Procedures. Mexico, CIMMYT.

Byerlee, D., and C. K. Eicher. (1974). "Rural Employment, Migration, and Economic Development: Theoretical Issues and Empirical Evidence From Africa" in Agricultural Policy in Developing Countries, N. Islam, ed. New York, Macmillan, pp. 273-313.

Byerlee, D.; C. K. Eicher; C. Liedholm; and D. Spencer. (1977). Rural Employment in Tropical Africa: Summary of Findings. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 20.

_____. (1982). "Employment-Output Conflicts, Factor Price Distortions and Choice of Technique: Empirical Results from Sierra Leone." Econ. Dev. and Cultural Change. (In Press).

Byerlee, D.; J. L. Tommy; and H. Fatoo. (1976). Rural-Urban Migration in Sierra Leone: Determinants and Policy Implications. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Paper No. 13.

Caldwell, J. C. (1969). African Rural-Urban Migration: The Movement to Ghana's Towns. New York, Columbia Univ. Press.

_____. (1975). The Sahelian Drought and Its Demographic Implications. Washington, ACE, Overseas Liaison Committee, Paper No. 8.

_____. (1976). "Toward a Restatement of Demographic Transition Theory." Population and Development Review 2:321-366.

Caldwell, J. C.; N. O. Addo; S. K. Gaisie; A. Igun; and P. O. Olusanya, eds. (1975). Population Growth and Socio-Economic Change in West Africa. New York, Columbia Univ. Press.

Callaway, A. (1964). "Nigeria's Indigenous Education: The Apprenticeship System." ODU, Journal of the University of Ife 1(1):62-79.

Calvet, H.; D. Friot; and I. S. Gueye. (1976). Revue d'elevage et de medicine veterinaire des tropicaux 29:59-66.

Campbell, B. (1974). "Social Change and Class Formation in a French West African State." Canadian J. African Studies 8(2):285-306.

Campbell, D. (1979). "Development or Decline: Resources, Land Use and Population Growth in Kajiado District." Nairobi, Univ. of Nairobi, IDS Working Paper No. 352.

Candler, W., and R. Slade. (1981). "Collection of Reliable Farm Level Data in LDCs." J. Agr. Econ. 30(1):65-70.

Cannell, G. H., ed. (1977). Proceedings of an International Symposium on Rainfed Agriculture in Semi-Arid Regions, April 17-22, 1977, Riverside, California. Riverside, California, Univ. of California and Corvallis, Oregon, Oregon State Univ., Consortium of Arid Lands Institute.

Cantrelle, P., ed. (1974). Population in African Development. Vol. 1. Dolhain, Belgium, Ordina Editions for the International Union for the Scientific Study of Population.

Capron, J. (1973). Communaute villageoise Bwa, Mali - Haute-Volta. Paris, Musee de l'Homme.

Cardoso, F. H., and E. Faletto. (1979). Dependency and Development in Latin America. Berkeley and Los Angeles, Univ. of California Press.

Carruthers, I., and A. Weir. (1976). "Rural Water Supplies and Irrigation Development" in Heyer, Maitha, and Senga, 1976, pp. 288-312.

Catt, C. (1966). "Surveying Peasant Farmers - Some Experiences." J. Agr. Econ. 17(1):99-100.

Catt, D. C. (1970). Progress in African Agriculture: An Economic Study in Malawi. Aberdeen, Scotland, School of Agriculture, Miscellaneous Pub. No. 11.

CGIAR, Technical Advisory Committee. (1978). Farming Systems Research at the International Agricultural Research Centers. Rome, TAC Secretariat.

Chabrolin, R. (1977). "Rice in West Africa" in Leakey and Wills, 1977, pp. 7-25.

Chambers, R. (1969). Settlement Schemes in Tropical Africa: A Study of Organizations and Development. London, Routledge and Paul.

Chambers, R., ed. (1970). The Volta Resettlement Experience. London, Pall Mall.

_____. (1974). Managing Rural Development: Ideas and Experience From East Africa. Uppsala, Sweden, Scandinavian Institute of African Studies.

Chambers, R., and J. R. Moris, eds. (1973). Mwea: An Irrigated Rice Settlement in Kenya. Munich, Weltforum Verlag.

Charlick, R. (1972). "Participatory Development and Rural Modernization in Hausa Niger." African Rev. 2(4):499-524.

_____. (1980). "Animation Rurale: Experience with 'Participatory' Development in Four West African Nations." Rural Development Participation Rev. (Cornell University) 1(2):1-6.

Charreau, C. (1972). "Problemes poses par l'utilisation agricole des sols tropicaux par des cultures annuelles." L'Agronomie Tropicale 27(9):905-929.

_____. (1977). "Some Controversial Technical Aspects of Farming Systems in Semi-Arid West Africa" in Cannell, 1977, pp. 313-360.

Charreau, C., and R. Nicou. (1971). "L'amelioration du profil cultural dans les sols sableux et sablo-argileux de la zone tropicale seche Ouest Africaine et ses incidences agronomiques." L'Agronomie Tropicale 26(2):209-255; (5):565-631; (9):903-978; (11):1184-1247.

Chayanov, A. V. (1925). Peasant Farm Organization. Moscow, Cooperative Publishing House. (Reprinted in The Theory of Peasant Economy, D. Thorner, B. Kerblay, and R. E. F. Smith, eds. Homewood, Ill., Richard D. Irwin, 1966.)

Chenery, H. B.; M. S. Ahluwalia; C. L. G. Bell; J. H. Duloy; and R. Jolly, eds. (1974). Redistribution with Growth. London, Oxford Univ. Press.

Chenery, H. B., and M. Syrquin. (1975). Patterns of Development, 1950-70. London, Oxford Univ. Press.

Child, F. C. (1977). Small-Scale Rural Industry in Kenya. Los Angeles, Univ. of California, African Studies Center Occasional Paper No. 17.

Chileshe, J. H. (1977). The Challenge of Developing Intra-African Trade. Kampala, Uganda, East African Literature Bureau.

Chopart, J.-L., and R. Nicou. (1976). "Influence du labour sur le developpement radiculaire de differentes plantes cultivees au Senegal. Consequences sur leur alimentation hydrique." L'Agronomie Tropicale 31(1):7-28.

Christensen, J. B. (1977). "Motor Power and Women Power: Technological and Economic Change Among the Fanti Fishermen of Ghana" in Those Who Live From the Sea: A Study in Maritime Anthropology, M. E. Smith, ed. St. Paul, Minnesota, West Publishing Co. for the Amer. Ethnological Society, Monograph No. 62, pp. 71-95.

Christy, F. T. (1976). "Effective Fisheries Management with Regional Diversities." Development Digest 14(3):26-37.

Chuta, E. (1978). The Economics of the Gara (Tie-Dye) Cloth Industry in Sierra Leone. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 25.

Chuta, E., and C. Liedholm. (1979). Rural Non-Farm Employment: A Review of the State of the Art. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Paper No. 4.

Chuta, E.; C. Liedholm; O. Roberts; and J. Tommy. (1981). Employment Growth and Change in Sierra Leone Small Scale Industry: 1974-1980. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 37.

CILSS/Club du Sahel (Working Group on Marketing, Price Policy, and Storage). (1977). Marketing, Price Policy and Storage of Food Grains in the Sahel: A Survey. 2 vols. Ann Arbor, Univ. of Michigan, Center for Research on Economic Development.

CILSS/Club du Sahel. (1978a). Energy in the Development Strategy of the Sahel: Situation-Perspectives-Recommendations. Paris, OECD, Club du Sahel and CILSS.

_____. (1978b). La mise en valeur des 'terres neuves' au Sahel. (Synthese du seminaire de Ouagadougou, 10-13 Octobre 1978). Paris, OECD.

_____. (1979). Cereals Policy in Sahel Countries. (Papers presented at the Nouakchott Colloquium, Mauritania, 2-6 July 1979.) Paris, OECD.

CILSS/Club du Sahel (Working Group on Recurrent Costs). (1980a). Recurrent Costs of Development Programs in the Countries of the Sahel: Analysis and Recommendations. Paris, OECD, Club du Sahel, and Ouagadougou, CILSS.

CILSS/Club du Sahel (Working Group on Irrigation). (1980b). The Development of Irrigated Agriculture in the Sahel: Review and Perspectives. Paris, OECD, Club du Sahel and Ouagadougou, CILSS.

CIMMYT. (1981). CIMMYT Review, 1981. Mexico, CIMMYT.

CIMMYT, Eastern African Economics Programme. (1977a). Demonstrations of an Interdisciplinary Approach to Planning Adaptive Agricultural Research Programmes: Part of Siaya District, Nyanga Province, Kenya. Nairobi, Kenya, CIMMYT with Egerton College and the Kenya Ministry of Agriculture, Report No. 1.

_____. (1977b). Demonstrations of an Interdisciplinary Approach to Planning Adaptive Agricultural Research Programmes: The Drier Areas of Morogoro and Kilosa Districts, Tanzania. Nairobi, Kenya, CIMMYT with Tanzania Ministry of Agriculture and Univ. of Dar es Salaam, Faculty of Agriculture, Report No. 2.

_____. (1978). Demonstrations of an Interdisciplinary Approach to Planning Adaptive Agricultural Research Programmes: Part of Serenji District, Central Province, Zambia. Nairobi, Kenya, CIMMYT with Zambia Ministry of Agriculture and Univ. of Zambia, Rural Development Studies Bureau, Report No. 3.

Clammer, J. (1975). "Economic Anthropology and the Sociology of Development: 'Liberal' Anthropology and Its French Critics" in Oxaal, Barnett, and Booth, pp. 208-228.

Clark, B. A. (1975). "The Work Done by Rural Women in Malawi." Eastern Africa J. Rural Development 8:80-91.

Clayton, E. S. (1961). "Technical and Economic Optima in Peasant Agriculture." J. Agr. Econ. 14:337-377.

_____. (1963). Economic Planning in Peasant Agriculture: A Study of the Optimal Use of Agricultural Resources by Peasant Farmers in Kenya. Ashford, Kent, Wye College, Dept. of Econ.

_____. (1964). Agrarian Development in Peasant Economies: Some Lessons From Kenya. Oxford, Pergamon Press.

_____. (1975). "Programming Rural Employment Opportunities in Kenya." International Labour Rev. 112:149-161.

_____. (1978). A Comparative Study of Settlement Schemes in Kenya. London, Univ. of London, Wye College, Occasional Paper No. 3.

_____. (1981). "Monitoring, Management and Control of Irrigation Projects: The Example of Mwea, Kenya." Water Supply and Management (Oxford) 5(1):107-115.

Cleave, J. H. (1968). "Food Consumption in Uganda." East African J. Rural Development 1(1):70-87.

_____. (1974). African Farmers: Labour Use in the Development of Smallholder Agriculture. New York, Praeger.

_____. (1977). "Decision-Making on the African Farm." Contributed Papers Read at the 16th International Conference of Agricultural Economists. Nairobi, Oxford Univ. Press, pp. 157-177.

Cliffe, L. (1976). "Rural Political Economy of Africa" in Gutkind and Wallerstein, pp. 112-130.

_____. (1978). "Labour Migration and Peasant Differentiation: Zambian Experiences." J. Peasant Studies 5(3):326-346. Reprinted in Turok, pp. 149-169.

Clower, R. W.; G. Dalton; M. Harwitz; and A. A. Walters. (1966). Growth Without Development: An Economic Survey of Liberia. Evanston, Illinois, Northwestern Univ. Press.

Club du Sahel. (1977). Strategy and Programme for Drought Control and Development in the Sahel. Paris, OECD.

Cohen, A. (1965). "The Social Organization of Credit in a West African Cattle Market." Africa 35(1):8-20.

_____. (1971). "Cultural Strategies in the Organization of Trading Diasporas" in Meillassoux, pp. 266-281.

Cohen, J. M. (1975). "Effects of Green Revolution Strategies on Tenants and Small-scale Landowners in the Chilalo Region of Ethiopia." J. Developing Areas 9:335-358.

_____. (1980a). "Integrated Rural Development: Clearing Out the Underbrush." Sociologia Ruralis 20(3):196-211.

_____. (1980b). "Land Tenure and Rural Development in Africa" in Bates and Lofchie, 1980, pp. 349-400.

Collier, P. (1979). "Migration and Unemployment: A Dynamic General Equilibrium Analysis Applied to Tanzania." Oxford Economic Papers 31(2):205-236.

Collins, J. D. (1976). "The Clandestine Movement of Groundnuts Across the Niger-Nigeria Boundary." Canadian J. African Studies 10(2):259-278.

Collinson, M. P. (1962-4). Farm Management Survey Report. No. 1, 2, 3, 4. Ukiriguru Research Station, Tanganyika, Ministry of Agriculture.

_____. (1968). "The Evaluation of Innovations for Peasant Farming." Eastern Africa J. Rural Development 1(2):50-59.

_____. (1972). Farm Management in Peasant Agriculture: A Handbook for Rural Development Planning in Africa. New York, Praeger.

_____. (1981). "Micro-Level Accomplishment and Challenges for the Less-Developed World" in Rural Change: The Challenge for Agricultural Economists. Proceedings, Seventeenth International Conference of Agricultural Economists, 3-12 September, Banff, Canada, G. L. Johnson and A. Maunder, eds. Westmead, England, pp. 43-53.

_____. (1982). Farming Systems Research in Eastern Africa: The Experience of CIMMYT and Some National Agricultural Research Services, 1976-81. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU International Development Paper No. 3.

Collis, W. R. E.; I. Dema; and A. Omololu. (1962). "On the Ecology of Child Health and Nutrition in Nigerian Villages: Part I. Environment, Population and Resources." Tropical and Geographical Medicine 14:140-163.

Colson, E. (1971). The Social Consequences of Resettlement: The Impact of the Kariba Resettlement Upon the Gwembe Tonga. Manchester, Manchester Univ. Press for the Univ. of Zambia.

Colvin, L. G.; C. Ba; B. Barry; J. Faye; A. Hamer; M. Soumah; and F. Sow. (1981). The Uprooted of the Western Sahel: Migrants' Quest for Cash in the Senegambia. New York, Praeger.

Copans, J., ed. (1975). Secheresses et famines du Sahel: I. Ecologie, denutrition, assistance. II. Paysans et nomads. Paris, Maspero.

Copans, J.; Ph. Couty; J. Roch; and G. Rocheteau. (1972). Maintenance sociale et changement economique au Senegal. I. Doctrine economique et pratique du travail chez le Mourides. Paris, ORSTOM, Travaux et documents de l'ORSTOM No. 15.

Copans, J.; J. Monod; K. Gough; and J. Pouillon. (1970/71). "Les responsabilities sociales et politiques de l'anthropologue." Les Temps Modernes 27(293-294):1121-1201.

Coquery-Vidrovitch, C. (1978). "Research on an African Mode of Production" in Seddon, pp. 261-288.

Coulibaly, S.; J. Gregory; and V. Piche. (1980). Les migrations Voltaiques (tome 1) importance et ambivalence de la migration Voltaique. Ottawa, IDRC.

Coulson, A. (1977a). "Tanzania's Fertiliser Factory." J. Modern African Studies 15:119-125.

_____. (1977b). "Agricultural Policies in Mainland Tanzania." Rev. African Political Economy 10:74-100.

_____, ed. (1979). African Socialism in Practice: The Tanzanian Experience. Nottingham, UK, Spokesman.

Coursey, D. G. (1967). Yams: An Account of the Nature, Origins, Cultivation and Utilisation of the Useful Members of the Dioscoreaceae. London, Longmans.

Coursey, D. G., and R. H. Booth. (1977). "Root and Tuber Crops" in Leakey and Wills, pp. 75-96.

Couty, Ph. (1964). Le commerce du poisson dans le Nord-Cameroun. Paris, ORSTOM, Memoires ORSTOM No. 5.

_____. (1977). "Recent Studies on Traditional Agricultural Marketing in the Sudan and Sahel Zones of Africa" in Cannell, 1977, pp. 628-653.

_____. (1979). Des elements aux systemes. Reflexions sur les procedes de generalisation dans les enquetes de niveau de vie en Afrique. Paris, INSEE, AMIRA note de travail no. 28.

Couty, Ph., and P. Duran. (1968). Le commerce du poisson au Tchad. Paris, ORSTOM, Memoires ORSTOM No. 23.

Couty, Ph., and A. Hallaire. (1980). De la carte aux systemes - les etudes agraires de l'ORSTOM au Sud du Sahara (1960-1980). Paris, INSEE, AMIRA note de travail No. 29.

Coward, E. W. (1977). "Irrigation Management Alternatives: Themes from Indigenous Irrigation Systems." Agricultural Administration 4(3):223-237.

Coward, E. W., ed. (1980). Irrigation and Agricultural Development in Asia: Perspectives from the Social Sciences. Ithaca, Cornell Univ. Press.

Cowen, M. (1981). "Commodity Production in Kenya's Central Province" in Heyer, Roberts, and Williams, pp. 121-142.

Crawford, E. W. (1982). A Simulation Study of Constraints on Traditional Farming Systems in Northern Nigeria. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU International Development Paper No. 2.

Crotty, R. (1980). Cattle, Economics and Development. Farnborough, Commonwealth Agricultural Bureau.

Cruise O'Brien, D. B. (1975). Saints and Politicians: Essays in the Organisation of a Senegalese Peasant Society. London, Cambridge Univ. Press.

Cruise O'Brien, R., ed. (1979). The Political Economy of Underdevelopment: Dependence in Senegal. Beverly Hills, California, Sage.

Crutchfield, J. A., and R. Lawson. (1974). West African Marine Fisheries: Alternatives for Management. Washington, Resources for the Future, Program of International Studies of Fishery Arrangements, Paper No. 3.

Dahl, G. (1979). Suffering Grass: Subsistence and Society of Waso Borana. Stockholm, Univ. of Stockholm.

Dahl, G., and A. Hjort. (1976). Having Herds: Pastoral Growth and Household Economy. Stockholm, Univ. of Stockholm, Studies in Social Anthropology No. 2.

_____. (1979). Pastoral Change and the Role of the Drought. Stockholm, SAREC, Report No. 2.

Dalby, D., and R. J. Harrison Church, eds. (1973). Drought in Africa. London, Univ. of London, School of Oriental and African Studies.

Dalby, D.; R. J. Harrison Church; and F. Bezzaz, eds. (1977). Drought in Africa. Vol. 2. London, International African Institute.

Dalton, G. (1962). "Traditional Production in Primitive African Economies." Quart. J. Econ. 76:360-378.

_____. (1976). "A Review of 'An Economic History of West Africa' by A. G. Hopkins." African Econ. History 1:51-101.

_____. (1978). "Is Economic Anthropology of Interest to Economists?" Amer. Econ. Rev. Papers and Proceedings 68:23-27.

Dalton, G. E. (1973). "Adaption of Farm Management Theory to the Problems of the Small-Scale Farmer in West Africa" in Ofori, 1973, pp. 114-129.

Dams, T., and K. Hunt, eds. (1977). Decision-Making and Agriculture. Lincoln and London, Univ. of Nebraska Press.

Darling, F. F., and M. A. Farvar. (1972). "Ecological Consequences of Sedentarization of Nomads" in Farvar and Milton, pp. 671-682.

Datoo, B. A. (1973). Population Density and Agricultural Systems in the Uluguru Mountains, Morogoro District. Dar es Salaam, Univ. of Dar es Salaam, BRALUP, Research Paper No. 26.

David, P. (1980). Les Navetanes: histoire des migrants saisonniers de l'arachide en Senegambie des origines a nos jours. Dakar-Abidjan, Les Nouvelles Editions Africaines.

David, P. A. (1975). "The Mechanization of Reaping in the Ante-Bellum Midwest" in Technical Choice, Innovation and Economic Growth: Essays on American and British Experience in the Nineteenth Century. Cambridge, Cambridge Univ. Press, pp. 195-232.

Davies, J. C. (1976). "Trials of Spraying and Cultural Practices on Cotton in Uganda. II. Use of Extended Protection." Experimental Agriculture 12(2):163-176.

Davis, R. K. (1971). "Some Issues in the Evolution, Organization and Operation of Group Ranches in Kenya." Eastern Africa J. Rural Development 4(1):22-33.

Dean, E. R. (1966). The Supply Response of African Farmers: Theory and Measurement in Malawi. Amsterdam, North Holland.

_____. (1972). Plan Implementation in Nigeria: 1962-66. Ibadan, Nigeria, Oxford Univ. Press.

De Carvalho, E. C. (1974). " 'Traditional' and 'Modern' Patterns of Cattle Raising in Southwestern Angola: A Critical Evaluation of Change From Pastoralism to Ranching." J. Developing Areas 8(2):199-226.

Deelstra, H. A.; D. White; and D. S. Wiggins. (1974). "Nutritive Value of Fish of Lake Tanganyika. I. Amino Acid Composition." African J. Tropical Hydrobiology and Fisheries 3(2):161-166.

De Janvry, A. (1975). "The Political Economy of Rural Development in Latin America: An Interpretation." Amer. J. Agr. Econ. 57:490-499.

_____. (1982). The Agrarian Question and Reformism in Latin America. Baltimore, Johns Hopkins Univ. Press.

Dejene, T., and S. E. Smith. (1973). Experiences in Rural Development: A Selected, Annotated Bibliograpy of Planning, Implementation and Evaluating Rural Development in Africa. Washington, ACE, Overseas Liaison Committee.

De Jonge, K.; J. van der Klei; H. Meilink; and R. Storm. (1978). Les migrations en basse Casamance (Senegal). Leiden, Netherlands, Africa-Studiecentrum.

De Leeuw, P. N. (1965). "The Role of Savanna in Nomadic Pastoralism." Netherlands J. Agr. Science 13(2):178-189.

Delgado, C. (1979a). Livestock Versus Foodgrain Production in Southeast Upper Volta: A Resource Allocation Analysis. Ann Arbor, Univ. of Michigan, CRED, Livestock Production and Marketing in the Entente States of West Africa, Monograph No. 1.

_____. (1979b). The Southern Fulani Farming System in Upper Volta: A Model for the Integration of Crop and Livestock Production in the West African Savannah. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Paper No. 20.

_____. (1980). "Livestock and Meat Production, Marketing, and Exports in Mali: A Review of the Evidence" in Ariza-Nino and Steedman, 1980, pp. 211-439.

Delpechi, B., and J.-M. Gastellu. (1974). Maintenance sociale et changement economique au Senegal. II. Pratique du travail et reequilibres sociaux en milieu Serer. Paris, ORSTOM, Travaux et Documents de l'ORSTOM No. 34.

De Miranda, E., and R. Billaz. (1980). "Methodes de recherche en milieu Sahelien: les approches ecologiques et agronomiques d'une pluridisciplinaire: l'exemple de Maradi au Niger." L'Agronomie Tropicale 35(4):357-373.

Derman, W., and L. Derman. (1973). Serfs, Peasants, and Socialists--A Former Serf Village in the Republic of Guinea. Berkeley, Univ. of California Press.

Des Bouvrie, C., and J. R. Rydzewski. (1977). "Irrigation" in Leakey and Wills, pp. 161-193.

De Schlippe, P. (1956). Shifting Cultivation in Africa: The Zande System of Agriculture. London, Routledge and Paul.

Desfosses, H., and J. Levesque, eds. (1975). Socialism in the Third World. New York, Praeger.

De Vries, J. (1976). "On the Effectiveness of Agricultural Extension: A Case Study of Maize Growing Practices in Iringa, Tanzania." Eastern Africa J. Rural Development 9(1-2):37-56.

_____. (1978). "Agricultural Extension and Development--Ujamaa Villages and the Problems of Institutional Change." Community Dev. J. 13:11-19.

De Wet, J. M. J. (1977). "Domestification of African Cereals." African Econ. History 3:15-32.

De Wilde, J. C. (1980). "Price Incentives and African Agricultural Development" in Bates and Lofchie, pp. 46-66.

De Wilde, J. C.; P. F. M. McLoughlin; A. Guinard; T. Scudder; and R. Maubouche. (1967). Experiences With Agricultural Development in Tropical Africa. Vol. 1. The Synthesis. Vol. 2. The Case Studies. Baltimore, Johns Hopkins Univ. Press.

Diallo, M. (1980). "Comparative Analysis of Capital Intensive and Labor Intensive Rice Irrigation Perimeters in the Senegal River Valley." M.Sc. Thesis, Michigan State Univ.

Diarra, F. A. (1971). Femmes Africaines en devenir: les femmes Zarma du Niger. Paris, Editions Anthropos.

Diarra, M. S. (1975). "Les problemes de contact entre les pasteurs peul et les agriculteurs dans le Niger central" in Monod, pp. 284-297.

Diehl, L., and F. E. Winch. (1979). Yam Based Farming Systems in the Southern Guinnea Savannah of Nigeria. Ibadan, Nigeria, IITA, Agricultural Economics Discussion Paper No. 1180.

Dike, K. O. (1956). Trade and Politics in the Niger Delta, 1830-1885. Oxford, Oxford Univ. Press.

Dillon, J. L. and J. B. Hardaker. (1980). Farm Management Research for Small Farmer Development. Rome, FAO, Agricultural Services Bulletin No. 41.

Dodge, D. (1977). Agricultural Policy and Performance in Zambia: History, Prospects and Proposals for Change. Berkeley, Univ. of California, Institute of International Studies.

Doggett, H. (1970). Sorghum. London, Longmans.

Doherty, D. A. (1979). A Preliminary Report on Group Ranching in Narok District. Nairobi, Nigeria, Univ. of Nairobi, IDS Working Paper No. 350.

Donald, G. (1976). Credit for Small Farmers in Developing Countries. Boulder, Colorado, Westview Press.

Donaldson, G. F., and J. D. von Pischke. (1973). "A Survey of Small Farmer Credit in Kenya." Aid Spring Review of Small Farmer Credit. Vol. VII. Kenya. Washington, USAID.

Doppler, W. (1980). The Economics of Pasture Improvement and Beef Production in Semi-Humid West Africa. Eschborn, German Agency for Technical Cooperation.

Doran, M. H.; A. R. C. Low; and R. L. Kemp. (1979). "Cattle as a Store of Wealth in Swaziland: Implications for Livestock Development and Overgrazing in Eastern and Southern Africa." Amer. J. Agr. Econ. 61(1):41-47.

Dorjahn, V. R., and B. R. Isaac, eds. (1979). Essays on the Economic Anthropology of Liberia and Sierra Leone. Philadelphia, Institute for Liberian Studies, Liberian Studies Monograph Series No. 6.

Dorner, P., ed. (1977). Cooperative and Commune: Group Farming in the Economic Development of Agriculture. Madison, Univ. of Wisconsin Press.

Dorward, D. C. (1975). "An Unknown Nigerian Export: TIV Benniseed Production, 1900-1960." J. African History 16:431-459.

Dos Santos, T. (1970). "The Structure of Dependence." Amer. Econ. Rev. 40(2):231-236.

Doyle, C. J. (1974). "Productivity, Technical Change, and the Peasant Producer: A Profile of the African Cultivator." Food Research Institute Studies 13:61-76.

Due, J. F. (1979). "The Problems of Rail Transport in Tropical Africa." J. Developing Areas 13(4):375-393.

Due, J. M. (1980). Costs, Returns and Repayment Experiences of Ujamaa Villages in Tanzania, 1973-1976. Lanham, Maryland, Univ. Press of America.

_____. (1981). "Allocation of Credit to Ujamaa Villages in Tanzania and Small Farms in Zambia." The African Studies Review 22(3):33-48.

Duignan, P., and L. H. Gann, eds. (1975). Colonialism in Africa, 1870-1960. Vol. 4. The Economics of Colonialism. Cambridge, Cambridge Univ. Press.

Dumett, R. (1971). "The Rubber Trade of the Gold Coast and Asante in the Nineteenth Century: African Innovation and Market Responsiveness." J. African History 12(1):79-101.

Dumont, R. (1966). False Start in Africa. New York, Praeger.

_____. (1969). Tanzanian Agriculture After the Arusha Declaration. Dar es Salaam, Tanzania, Govt. Printer.

_____. (1977). "Preface." African Environment 213:3-5.

Dumont, R., and M.-F. Mottin. (1980). L'Afrique Etranglee: Zambie, Tanzanie, Senegal, Cote-Ivoire, Guinee-Bissau, Cap Vert. Paris, Editions du Seuil.

Dunbar, G. S. (1970). "African Ranches Ltd., 1914-1931: An Ill-Fated Stockraising Enterprise in Northern Nigeria." Annals of the Association of American Geographers 60(1):102-123.

Dupire, M. (1960). "Planteurs autochtones et etrangers en basse-Cote d'Ivoire Orientale." Etudes Eburneennes 8:7-237. Abidjan.

_____. (1962). Peuls nomades: etude descriptive des WoDaaBe du Sahel Nigerien. Paris, Institut d'Ethnologie, Musee de l'Homme, Trav. and Mem., No. 64.

Dupre, G., and P. Ph. Rey. (1978). "Reflections on the Relevance of a Theory of the History of Exchange" in Seddon, pp. 171-208.

Dupriez, H. (1979). Integrated Rural Development Projects Carried Out in Black Africa with EDF Aid: Evaluation and Outlook for the Future. Luxembourg, Office for Official Publications of the European Communities.

Dussauze-Ingrand, E. (1974). "L'emigration sarakollaise du guidimaka vers la France" in Amin, 1974a, pp. 239-257.

Dutta-Roy, D. K. (1969). The Eastern Region Household Budget Survey. Legon, Ghana, Univ. of Ghana, ISSER, Technical Publication Series No. 6.

Dutta-Roy, D. K., and S. J. Mabey. (1968). Household Budget Survey in Ghana. Legon, Ghana, Univ. of Ghana, ISSER, Technical Publication Series No. 2.

Dyson-Hudson, N. (1972). "The Study of Nomads." J. Asian and African Studies 7(1,2):30-47.

Easterlin, R. A., ed. (1980). Population and Economic Change in Developing Countries. Chicago, Univ. of Chicago Press.

Eastman, P. (1980). An End to Pounding: A New Mechanical Flour Milling System in Use in Africa. Ottawa, Canada, IDRC.

Eberhart, S. A.; L. H. Penny; and M. N. Harrison. (1973). "Genotype by Environment Interactions in Maize in Eastern Africa." East African Agr. and Forestry J. 39:61-71.

Eckert, J., and R. Wykstra. (1979). The Future of Basotho Migration to the Republic of South Africa. Maseru, Lesotho, Ministry of Agriculture; and Colorado State Univ., Dept. of Econ., LASA Research Report No. 4.

Eddy, E. (1979). Labor and Land Use on Mixed Farms in the Pastoral Zone of Niger. Ann Arbor, Univ. of Michigan, CRED, Livestock Production and Marketing in the Entente States of West Africa, Monograph No. 3.

Egbert, A. C. (1978). Agricultural Sector Planning Models: A Selected Summary and Critique. Washington, World Bank, Staff Working Paper No. 297.

Eicher, C. K. (1967). "The Dynamics of Long-Term Agricultural Development in Nigeria." J. Farm Econ. 49:1158-1170.

_____. (1969). "Reflections on Capital Intensive Farm Settlements in Southern Nigeria" in Anschel, Brannon, and Smith, pp. 327-346.

_____. (1970). Research on Agricultural Development in Five English-Speaking Countries in West Africa. New York, ADC.

_____. (1982). "Facing Up to Africa's Food Crisis." Foreign Affairs 61(1):151-174.

Eicher, C. K., and G. L. Johnson. (1970). "Policy for Nigerian Agricultural Development in the 1970's" in Eicher and Liedholm, 1970, pp. 376-392.

Eicher, C. K., and C. Liedholm, eds. (1970). Growth and Development of the Nigerian Economy. East Lansing, Michigan State Univ. Press.

Eicher, C. K.; M. Sargent; E. K. Tapsoba; and D. C. Wilcock. (1976). An Analysis of the Eastern ORD Rural Development Project in Upper Volta. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Employment Working Paper No. 9.

Eicher, C. K., and L. W. Witt, eds. (1964). Agriculture in Economic Development. New York, McGraw-Hill.

Eicher, C. K.; T. Zalla; J. Kocher; and F. Winch. (1970). Employment Generation in African Agriculture. East Lansing, Michigan State Univ., Institute of Int. Agr., Research Report No. 9.

Eicher, S. F. (1981). Rural Development in Botswana: A Select Bibliography, 1966-80. Washington, African Bibliographic Center.

Eilam, Y. (1973). The Social and Sexual Roles of Hima Women: A Study of Nomadic Cattle Breeders in Nyabushozi Country, Ankola, Uganda. Manchester, Manchester Univ. Press.

Ejiga, N. O. O. (1977). "Economic Analysis of Storage, Distribution and Consumption of Cowpeas in Northern Nigeria." Ph.D. dissertation, Cornell Univ.

Ekeh, P. P. (1975). "Colonialism and the Two Publics in Africa: A Theoretical Statement." Comparative Studies in Society and History 17(1):91-112.

Elkan, W. (1959). "Migrant Labour in Africa: An Economist's Approach." Amer. Econ. Rev. Papers and Proceedings 49(2):188-202.

_____. (1980). "Labor Migration from Botswana, Lesotho and Swaziland." Econ. Dev. and Cultural Change 28(3):583-596.

Elliott, C. M. (1970). "Effects of Ill-Health on Agricultural Productivity in Zambia" in Bunting, pp. 647-655.

_____. (1980). Equity and Growth--Unresolved Conflict in Zambian Rural Development Policy. Geneva, ILO, World Employment Research Program, Working Paper No. 30.

Elliott, C. M.; J. E. Bessell; R. A. J. Roberts; and N. Vanzetti. (1970). "Some Determinants of Agricultural Labour Productivity in Zambia." Universities of Nottingham and Zambia, Agricultural Labour Productivity Investigation (UNZALPI), Report No. 3. (Mimeo).

Elliott, H. J. C. (1974). Animation Rurale and Encadrement Technique in the Ivory Coast. Ann Arbor, Univ. of Michigan, CRED, Discussion Paper No. 40.

Ellis, F. (1980). "Agricultural Pricing Policy in Tanzania, 1970-1979: Implications for Agricultural Output, Rural Incomes and Crop Marketing Costs," paper presented at a joint ILO/University of Dar es Salaam Seminar on Development, Employment and Equity Issues, 21-25 July 1980, Univ. of Dar es Salaam, Economic Research Bureau.

Ellis, G. (1972). "Man or Machine: Beast or Burden -- A Case Study of the Economics of Agricultural Mechanization in Ada District, Ethiopia." Unpublished Ph.D. dissertation, Univ. of Tennessee, Knoxville.

Ellman, A. (1977). "Group Farming Experiences in Tanzania" in Dorner, 1977, pp. 239-275.

Ergas, A. (1979). "Livestock Production and Marketing in the Entente States of West Africa: Annotated Bibliography" in Shapiro, et al., 1979.

Ernst, K. (1977). Tradition and Progress in the African Village: The Non-Capitalist Transformation of Rural Communities in Mali. London, C. Hurst.

Essang, S. (1972). "Impact of the Marketing Board on the Distribution of Cocoa Earnings in Western Nigeria." Nigerian Geographical J. 15:103-115.

_____. (1973). "The 'Land Surplus' Notion and Nigerian Agricultural Development Policy." West African J. Agr. Econ. 2(1):58-78.

_____. (1977). "Impact of Oil Production on Nigerian Agricultural Policy." Indian J. Agr. Econ. 32(2):24-32.

Essang, S. M., and A. F. Mabawonku. (1974). Determinants and Impact of Rural-Urban Migration: A Case Study of Selected Communities in Western Nigeria. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Employment Paper No. 10.

Essang, S. M., and O. Ogunfowora. (1975). Plantation Agriculture and Labour Use in Southern Nigeria. Ibadan, Nigeria, Univ. of Ibadan, Rural Development Paper No. 15.

Etasse, C. (1977). "Sorghum and Pearl Millet" in Leakey and Wills, 1977, pp. 27-39.

Etherington, D. M. (1971). "Economies of Scale and Technical Efficiency: A Case Study of Tea Production." Eastern Africa J. Rural Development 4(1):72-87.

_____. (1972). "An International Tea Trade Policy for East Africa: An Exercise in Oligopolistic Reasoning." Food Research Institute Studies 11:89-108.

_____. (1973). An Econometric Analysis of Smallholder Tea Production in Kenya. Nairobi, East African Literature Bureau.

Etuk, E. (1979). "Micro-economic Effects of Technological Change on Smallholder Agriculture in Northern Nigeria: A Linear Programming Analysis." Ph.D. dissertation, Michigan State Univ.

Ewing, A. F. (1964). "Industrialization and the U.N. Economic Commission for Africa." J. Modern African Studies 2(3):351-363.

_____. (1968). Industry in Africa. London, Oxford Univ. Press.

Ewusi, K. (1977). Economic Inequality in Ghana. Legon, Univ. of Ghana, ISSER.

Fall, M. (1980). "Socioeconomic Aspects Involved in Introducing New Technology Into the Senegalese Rural Milieu" in ICRISAT, 1980a, pp. 45-51.

Falusi, A. O. (1974/75). "Application of Multi-variate Probit to Fertilizer Use Decisions: Sample Survey of Farmers in Three States in Nigeria." J. Rural Econ. Development 9(1):49-66.

_____. (1976). "Economics of Fertilizer Use in Nigeria with Particular Reference to Food Crops." Report on the FAO/NORAD/FDA National Seminar on Fertilizer Use Development in Nigeria. AGL/MISC/76/3. Rome, FAO, pp. 100-107.

Falusi, A. O., and L. B. Williams. (1981). Nigeria Fertilizer Sector: Present Situation and Future Prospects. Muscle Shoals, Alabama, IFDC Technical Bulletin T-18.

FAO. (1966). Agricultural Development in Nigeria, 1965-80. Rome.

_____. (1973). Shifting Cultivation and Soil Conservation in Africa. Rome, FAO Soils Bulletin No. 24.

_____. (1974). A Selected Bibliography on Food Habits (Socio-Economic Aspects of Food and Nutrition) - Part I, Tropical Africa. Rome, Occasional Paper No. 10.

_____. (1975a). Production Yearbook: Africa South of the Sahara (1974). Rome.

_____. (1975b). "Assistance in Agricultural Mechanization in Tanzania." FAO Mission Report, September-October 1974. Rome.

_____. (1976a). Agricultural Development in Nigeria: 1965-1980. Rome.

_____. (1976b). Bibliography on Land Settlement. Rome.

_____. (1976c). Perspective Study on Agricultural Development in the Sahelian Countries, 1975-1990, Vol. I, Main Report; Vol. II, Statistical Annex; Vol. III, Summary and Conclusions. Rome.

_____. (1976d). "Prospects of Freshwater Fisheries Development for Africa" in Report of the Ninth FAO Regional Conference for Africa, Freetown, Sierra Leone, 2-12 November 1976. Rome, pp. 84-94.

_____. (1976e). Scope for Expanding Fruit and Vegetable Exports by Air From African Countries. Rome.

_____. (1977). The Pastoral Systems in the Sahel: Basic Socio-Demographic Data Connected with the Conservation and Development of Arid and Semi-Arid Rangelands. Rome.

_____. (1978). Regional Food Plan for Africa. Report of the Tenth FAO Regional Conference for Africa, 18-29 September, 1978, Tanzania. Rome.

_____. (1980). Assessment and Collection of Data on Post Harvest Food Grain Loss. Rome, Economic and Social Development Document No. 13.

_____. (1981a). Report of FAO Panel of Experts on Development Aspects of the Program for the Control of Animal Trypanosomiasis and Related Development. Rome.

_____. (1981b). A Grain Reserve System for the Sahel. Rome.

_____. (1981c). Bibliography of Food Consumption Surveys. Rome, FAO Food and Nutrition Paper No. 18.

FAO, Department of Fisheries. (1973). "Brief Review of the Current Status of the Inland Fisheries of Africa." Afr. J. Trop. Hydrobiology and Fisheries, Special Issue 1:3-19.

FAO and WHO. (1976). Food and Nutrition Strategies in National Development. Geneva, WHO, Technical Report Series No. 584.

Farnsworth, H. C. (1961). "Defects, Uses and Abuses of National Food Supply and Consumption Data." Food Research Institute Studies 2:179-201.

Farrington, J. (1975a). "Factors Influencing the Length of the Working Day in Malawi Agriculture." Eastern Africa J. Rural Development 8:61-79.

_____. (1975b). Farm Surveys in Malawi: The Collection and Analysis of Labour Data. Reading, Univ. of Reading, Dept. of Agr. Econ., Development Study No. 16.

_____. (1976). "A Note on Planned versus Actual Farmer Performance Under Uncertainty in Underdeveloped Agriculture." J. Agr. Econ. 27:257-260.

_____. (1977a). "Efficiency in Resource Allocation - A Study of Malawi Smallholders' Performance." Tropical Agriculture 54(2):97-106.

_____. (1977b). "Research-Based Recommendations versus Farmers' Practices: Some Lessons from Cotton-Spraying in Malawi." Experimental Agriculture 13(1):9-15.

Farvar, M. T., and J. P. Milton, eds. (1972). The Careless Technology: Ecology and International Development. Garden City, N. Y., Natural History Press.

Fauck, R. (1977). "Soil Erosion in the Sahelian Zone of Africa: Its Control and Its Effect on Agricultural Production" in Cannell, 1977, pp. 371-396.

Fauck, R.; C. Moureaux; and C. Thomann. (1969). "Bilans de l'evolution des sols de Sefa-Casamance (Senegal) apres quinze annees de culture continue." L'Agronomie Tropicale 24(3):263-301.

Faulkingham, R. H. (1977). "Ecological Constraints and Subsistence Strategies: The Impact of Drought in a Hausa Village: A Case Study From Niger" in Dalby, Church, and Bezzaz, 1977, pp. 148-158.

Faulkingham, R. H., and P. F. Thorbahn. (1975). "Population Dynamics and Drought: A Village in Niger." Population Studies 29(3):463-477.

Faure, H., and Jean Yves Gac. (1981). "Will the Sahelian Drought End in 1985?" Nature 291:475-478.

Faye, J.; T. Gallali and R. Billaz. (1977). "Peasant Agronomy: A Challenge to Planners' Models?" African Environment 2(4) and 3(1):37-46.

Faye, J., and M. Niang. (1977). "An Experiment in Agrarian Restructuration and Senegalese Rural Space Planning." African Environment 2(4) and 3(1):143-153.

Feldman, D. (1969). "The Economics of Ideology: Some Problems of Achieving Rural Socialism in Tanzania" in Politics and Change in Developing Societies: Studies in the Theory and Practice of Development, C. Leys, ed. Cambridge, Cambridge Univ. Press, pp. 85-111.

Felton, M. R., and P. P. Ellis. (1978). Studies on the Control of Rinderpest in Nigeria. Reading, Univ. of Reading, Dept. of Agr. and Hort, Study No. 23.

Ferguson, D. S. (1967). The Nigerian Beef Industry. Ithaca, Cornell Univ., International Agricultural Development Bulletin No. 9.

_____. (1976). A Conceptual Framework for the Evaluation of Livestock Production Development Projects and Programs in Sub-Saharan West Africa. Ann Arbor, Univ. of Michigan, CRED.

Ferguson, D. S., and J. Sleeper. (1976). "A Selected Bibliography of West African Livestock Development" in Ferguson, 1976.

Fields, G. (1975). "Rural-Urban Migration, Urban Unemployment and Underemployment, and Job Search Activity in LDC's." J. Dev. Econ. 2(2):165-188.

_____. (1980). "Internal Migration in Developing Countries: Comment" in Easterlin, 1980, pp. 390-394.

Fieloux, M. (1980). "A Socio Economic Study of a Toucouler Village, Bow (Senegal)" in Purdue Univ., 1980.

Firth, R. (1975). "The Skeptical Anthropologist: Social Anthropology and Marxist Views on Society" in Marxist Analyses and Social Anthropology, M. Block, ed. London, Malaby Press, pp. 29-60.

Fisher, N. M. (1977). "Studies in Mixed Cropping. I. Seasonal Differences in Relative Productivity of Crop Mixtures and Pure Stands in the Kenyan Highlands." Experimental Agriculture 13(2):177-184.

_____. (1979). "Studies in Mixed Cropping. III. Further Results with Maize-Bean Mixtures." Experimental Agriculture 15(1):49-58.

Flinn, J. C. (1975). "Economic Considerations in the Conduct of Cooperative Agricultural Research." Eastern Africa J. Rural Development 8:105-117.

Flinn, J. C.; B. M. Jellema; and K. L. Robinson. (1975). "Problems of Increasing Food Production in the Lowland Humid Tropics of Nigeria." Zeitschrift fur Auslandische Landwirtschaft 14(1):37-48.

Flinn, J. C., and J. Lagemann. (1980). "Evaluating Technical Innovations Under Low Resource Farmer Conditions." Experimental Agriculture 16:91-101.

Ford, D. J. (1971). "Long-Run Price Elasticities in the Supply of Kenyan Coffee: A Methodological Note." Eastern Africa Econ. Rev. 3(1):65-67.

Ford, J. (1971). The Role of Trypanosomiasis in African Ecology: A Study of the Tsetse Fly Problem. Oxford, Clarendon Press.

Forsyth, D. J. C. (1977). "Appropriate Technology in Sugar Manufacturing." World Development 5(3):189-202.

Fortmann, L. (1981). "The Plight of the Invisible Farmer: The Effect of National Agricultural Policy on Women in Africa" in Women and Technological Change in Developing Countries, R. Dauber and M. Cain, eds. Boulder, Colorado, Westview Press, pp. 205-214.

Fortmann, L., and E. Roe. (1981). Dam Groups in Botswana. London, ODI, Pastoral Network Paper 12b.

Foster, G. M.; T. Scudder; E. Colson; and R. V. Kemper, eds. (1979). Long-Term Field Research in Social Anthropology. New York, Academic Press.

Foster, H. L. (1978). "The Influence of Soil Fertility on Crop Performance in Uganda. I. Cotton." Tropical Agriculture (Trinidad) 55:255-268.

_____. (1980). "The Influence of Soil Fertility on Crop Performance in Uganda. II. Groundnuts." Tropical Agriculture (Trinidad) 57(1):29-42.

Fotzo, P. T., and F. E. Winch. (1978). The Economics of Rice Production in the North-West Province of Cameroon: Some Policy Considerations. Ibadan, Nigeria, IITA.

Fournier, F. (1967). "Research on Soil Erosion and Soil Conservation in Africa." African Soils 12:53-96.

Fowler, M. (1981). Overgrazing in Swaziland: A Review of the Technical Efficiency of the Swaziland Herd. London, ODI, Pastoral Network Paper 12d.

Franco, G. R. (1981). "The Optimal Producer Price of Cocoa in Ghana." J. Dev. Econ. 8(1):77-92.

Frank, A. G. (1966). "The Development of Underdevelopment." Monthly Rev. 18(4):17-31.

Frank, C. R. (1971). "The Problem of Urban Unemployment in Africa" in Employment and Unemployment Problems of the Near East and South Asia, R. Ridker and H. Lubell, eds. Delhi, Vikas Pub.

Franke, R. W., and B. H. Chasin. (1980). Seeds of Famime: Ecological Destruction and the Development Dilemma in the West African Sahel. Montclair, N. J., Allanheld and Osmun.

Fredrick, K. D. (1969). "The Role of Market Forces and Planning in Uganda's Economic Development, 1900-1938." East African Econ. Rev. 1:47-62.

Freund, W. M. and R. W. Shenton. (1977). "Vent-for-Surplus Theory and the Economic History of West Africa." Savanna 6(2):191-196.

Fricke, W. (1979). Cattle Husbandry in Nigeria: A Study of Its Ecological Conditions and Social-Geographical Differentiations. Heidelberg, West Germany, Univ. of Heidelberg, Heidelberger Geographischen Arbeiten No. 52.

Friedland, W. H., and C. G. Rosberg, eds. (1964). African Socialism. Stanford, California, Stanford Univ. Press.

Friedrich, K. H. (1977). Farm Management Data Collection and Analysis: An Electronic Data Processing Storage and Retrieval System. Rome, FAO.

Fumagalli, C. T. (1978). "An Evaluation of Development Projects Among East African Pastoralists" in P. Stevens, 1978, pp. 49-63.

Gaitskell, A. (1959). Gezira: A Story of Development in the Sudan. London, Faber and Faber.

Galaty, J. G.; D. Aranson; P. C. Salzman; and A. Chovinard, eds. (1981). The Future of Pastoral Peoples. Ottawa, IDRC.

Gallais, J. (1975). "Traditions pastorales et developpement: problemes actuels dans la region de Mopti (Mali)" in Monod, 1975, pp. 354-368.

_____, ed. (1977). Strategies pastorales et agricoles des Saheliens durant la secheresse, 1969-74. Bordeaux, Centre d'Etudes de Geographie Tropicale.

Galletti, R.; K. D. S. Baldwin; and I. O. Dina. (1956). Nigerian Cocoa Farmers: An Economic Survey of Yoruba Cocoa Farming Families. London, Oxford Univ. Press.

Galtung, J. (1971). "A Structural Theory of Imperialism." J. Peace Research 2:81-116.

_____. (1976). "The Lome Convention and Neo-Capitalism." African Rev. 6(1):33-42.

The Gambia. (1976). Cultivation and Ox-Drawn Implements. Banjul, The Gambia, Dept. of Agr., Technical Bulletin No. 1.

Gamble, D. P. (1979). A General Bibliography of the Gambia Up to 31 December, 1977. Boston, G. K. Hall.

Gastellu, J. M. (1980). "Mais ou sont donc ces unites economiques que nos amis cherchent tant en Afrique?" Cah. ORSTOM, ser. sci. Hum. 27(1-2):3-12.

Gaury, C. E. (1977). "Agricultural Mechanization" in Leakey and Wills, 1977, pp. 273-293.

Geertz, C. (1978). "The Bazaar Economy: Information and Search in Peasant Marketing." Amer. Econ. Rev. Papers and Proceedings 68(2):28-32.

Gellar, S.; R. B. Charlick; and Y. Jones. (1980). Animation Rurale and Rural Development: The Experience of Senegal. Ithaca, Cornell Univ., Rural Development Committee, Special Series on Animation Rurale No. 2.

Gemmill, G. T. (1971). "The Economics of Farm Mechanization in Malawi." Lilongwe, Malawi, Bunda College of Agr. (Mimeograph).

_____. (1979). "Elasticity of the Marketable Surplus of a Subsistence Crop at Various Stages of Development: Comment." Econ. Dev. and Cultural Change 28(1):175-178.

Gemmill, G., and C. K. Eicher. (1973). A Framework for Research on the Economics of Farm Mechanization in Developing Countries. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Employment Paper No. 6.

Gerhart, J. (1975). The Diffusion of Hybrid Maize in Western Kenya (abridged by CIMMYT). Mexico City, CIMMYT.

Gerold-Scheepers, T., and W. M. J. van Binsbergen. (1978). "Marxist and Neo-Marxist Approaches to Migration in Tropical Africa" in van Binsbergen and Meilink, pp. 21-35.

Ghai, D., and M. Godfrey, eds. (1979). Essays on Employment in Kenya. Nairobi, Kenya Literature Bureau.

Ghai, D., and S. Radwan. (1980). Growth and Inequality: Rural Development in Malawi, 1964-1978. Geneva, ILO, World Employment Research Program, Working Paper No. 35.

Gilbert, E. H.; D. W. Norman; and F. E. Winch. (1980). Farming Systems Research: A Critical Appraisal. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Paper No. 6.

Giles, G. W. (1975). "The Reorientation of Agricultural Mechanization for Developing Countries. Part I: Policies and Attitudes for Action Programs." AMA: Agricultural Mechanization in Asia 6(2):15-25.

Girdner, J.; V. Olorunsola; M. Froming; and E. Hanson. (1980). "Ghana's Agricultural Food Policy--Operation Feed Yourself." Food Policy 5(1):14-25.

Gladwin, C. H. (1975). "A Model of the Supply of Smoked Fish From Cape Coast to Kumasi" in Plattner, pp. 77-127.

Gladwin, H., and C. Gladwin. (1971). "Estimating Market Conditions and Profit Expectations of Fish Sellers at Cape Coast, Ghana" in Studies in Economic Anthropology, G. Dalton, ed. Washington, Amer. Anthropological Assoc., pp. 122-142.

Glantz, M. H., ed. (1976). The Politics of Natural Disaster: The Case of the Sahel Drought. New York, Praeger.

Goddard, A. D. (1972). "Land Tenure, Land Holding and Agricultural Development in the Central Sokoto Close-Settled Zone, Nigeria." Savanna 1(1):29-41.

Godelier, M. (1972). Rationality and Irrationality in Economics. Translation by B. Pearce. New York, Monthly Review Press.

Goe, M. R., and R. E. McDowell. (1980). Animal Traction: Guidelines for Utilization. Ithaca, Cornell Univ., International Agricultural Mimeograph 81.

Gooch, T. (1979). An Experiment With Group Ranches in Upper Volta. London, ODI, Pastoral Network Paper No. 9b.

Good, G. M. (1970). Rural Markets and Trade in East Africa: A Study of the Functions and Development of Exchange Institutions in Ankole, Uganda. Chicago, Univ. of Chicago, Dept. of Geography, Research Paper No. 128.

Goodwin, J. B. (1975). "An Analysis of the Effect of Price Distortion on the Development of the Rice Milling Industry in Ghana." Ph.D. dissertation, Univ. of Maryland.

Goody, J. R., ed. (1958). The Developmental Cycle in Domestic Groups. Cambridge, Cambridge Univ. Press.

_____, ed. (1975). Changing Social Structure in Ghana: Essays in the Comparative Sociology of a New State and an Old Tradition. London, International African Institute.

_____. (1980). "Rice-burning and The Green Revolution in Northern Ghana." J. Dev. Studies 16(2):136-155.

Goody, J., and J. Buckley. (1973). "Inheritance and Woman's Labour in Africa." Africa 43(2):108-121.

Gordon, R. J. (1977). Mines, Masters and Migrants: Life in a Namibian Compound. Johannesburg, Raven Press.

_____. (1978). The Women Left Behind: A Study of the Wives of the Migrant Workers of Lesotho. Geneva, ILO.

Goreux, L. M. (1977). Interdependence in Planning: Multi-Level Programming Studies of the Ivory Coast. Baltimore, Johns Hopkins Univ. Press.

Goulet, D. (1978). Looking at Guinea-Bissau: A New Nation's Development Strategy. Washington, ODC.

Grayzel, J. A. (1977). "The Ecology of Ethnic-Class Identity Among an African Pastoral People: The Doukoloma Fulbe." Ph.D. dissertation, Univ. of Oregon.

Green, R. H., and S. H. Hymer. (1966). "Cocoa in the Gold Coast: A Study in the Relations Between African Farmers and Agricultural Experts." J. Econ. History 26:299-319.

Greenland, D. J., and R. Lal, eds. (1977). Soil Conservation and Management in the Humid Tropics. Chichester, New York, Wiley.

Gregory, J. W. (1979). "Underdevelopment, Dependence and Migration in Upper Volta" in Shaw and Heard, pp. 73-94.

Griffin, K. (1976). "On the Emigration of the Peasantry." World Development 4(5):353-361.

Grindle, W. (1980). Economic Losses from East Coast Fever in Sukamaland, Tanzania. Edinburgh, Univ. of Edinburgh, Centre for Tropical Veterinary Medicine.

Grolleaud, M., and D. F. Kohler. (1979). Cereals Storage: Survey, Reflections and Suggestions. (Paper presented at the Nouakchott Colloque, Cereals Policy in Sahel Countries, Mauritania, 2-6 July 1979.) Paris, OECD.

Grove, A. T. (1974). "Desertification in the African Environment." African Affairs 73:137-151.

Guggenheim, H. (1978). "Of Millet, Mice and Men: Traditional and Invisible Technology Solutions to Post-Harvest Losses in Mali" in World Food, Pest Losses and the Environment, D. Pimentel, ed. Boulder, Colorado, Westview Press, pp. 109-162.

Gugler, J. (1969). "On the Theory of Rural-Urban Migration: The Case of Sub-Saharan Africa" in Jackson, pp. 134-155.

Gulhati, R. (1981). Industrial Strategy for Late Starters: The Experience of Kenya, Tanzania and Zambia. Washington, World Bank, Working Paper No. 457.

Gulland, A. (1973). "Resource Studies in Relation to the Development of African Inland Fisheries." Afr. J. Trop. Hydrobiology and Fisheries 1:21-25.

Gusten, R. (1967). "Can the Nigerian Economy Grow at 6 Percent Per Annum in the Near Future? A Pre-Planning Exercise." Nigerian J. Econ. Soc. Studies 9:11-32.

_____. (1968). Studies in the Staple Food Economy of Western Nigeria. New York, Humanities Press.

Guthrie, E. J., and F. F. Pinto. (1970). "Wheat Improvement in East Africa" in Leakey, pp. 88-98.

Gutkind, P. C. W., and I. Wallerstein, eds. (1976). The Political Economy of Contemporary Africa. Beverly Hills, California, Sage.

Guyer, J. I. (1980a). "Food, Cocoa and the Division of Labor by Sex in Two West African Societies." Comparative Studies in Society and History 22(3):355-373.

_____. (1980b). Household Budgets and Women's Incomes. Boston, Boston Univ., African Studies Center, Working Paper No. 28.

Gwyer, G. D. (1973). "Three International Commodity Agreements: The Experience of East Africa." Econ. Dev. and Cultural Change 21:465-476.

Hafkin, N. J., and E. G. Bay, eds. (1976). Women in Africa: Studies in Social and Economic Change. Stanford, California, Stanford Univ. Press.

Haggblade, S. (1978). "Africanization From Below: The Evolution of Camerounian Savings Societies Into Western Style Banks." Rural Africana 2:35-55.

Hall, M. (1968). "Agricultural Mechanization in East Africa" in Helleiner, 1968b, pp. 81-116.

_____. (1970). "A Review of Farm Management Research in East Africa." Agr. Econ. Bulletin for Africa 12:11-24.

Hamilton, A. G. (1975). A Review of Post-Harvest Technology: Botswana. Ottawa, Ontario, Canadian Univ. Service Overseas.

Hancock, W. K., Sr. (1942). Survey of British Commonwealth Affairs. Vol. II, Problems of Economic Policy, 1918-1939, Part 2. London, Oxford Univ. Press.

Handwerker, W. P. (1974). "Changing Household Organization in the Origins of Market Places in Liberia." Econ. Dev. and Cultural Change 22:229-248.

_____. (1981). "Productivity, Marketing Efficiency and Price Support Programs: Alternative Paths to Rural Development in Liberia." Human Organization 40(1):27-39.

Hansen, B. (1979). "Colonial Economic Development with Unlimited Supply of Land: A Ricardian Case." Econ. Dev. and Cultural Change 27(4):611-628.

Hanson, J. (1980). Is the School the Enemy of the Farm? East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Paper No. 22.

Harbeson, J. W. (1973). Nation Building in Kenya: The Role of Land Reform. Evanston, Illinois, Northwestern Univ. Press.

Hardaker, J. B. (1979). "A Review of Some Farm Management Research Methods for Small Farm Development in LDCs." J. Agr. Econ. 30(3):315-331.

Harper, M. (1975). "Sugar and Maize Meal: Cases of Inappropriate Technology From Kenya." J. Modern African Studies 13:501-509.

Harris, J. (1981). A Conceptual Framework for the Study of Migration in Botswana. Boston, Boston Univ., African Studies Center Working Paper No. 42.

Harris, J., and M. P. Todaro. (1970). "Migration, Unemployment and Development: A Two-Sector Analysis." Amer. Econ. Rev. 60:126-142.

Harris, S.; K. Porris, G. Ritson, and E. Tollens. (1978). The Re-negotiation of the ACP-EEC Convention of Lome, with Special Reference to Agricultural Products. London, Commonwealth Secretariat, Commonwealth Economic Paper No. 12.

Harrison, M. N. (1970). "Maize Improvement in East Africa" in C. L. A. Leakey, 1970, pp. 21-59.

Harriss, B. (1979a). "Going Against the Grain." Development and Change 10:363-384. Also in ICRISAT, 1980a, pp. 265-288.

_____. (1979b). "There Is Method In My Madness: Or Is It Vice Versa? Measuring Agricultural Market Performance." Food Research Institute Studies 17(2):197-218.

Hart, K. (1973). "Informal Income Opportunities and Urban Employment in Ghana." J. Modern African Studies 11:61-89.

Harwitz, M. (1978). "Improving the Lot of the Poorest: Economic Plans in Kenya" in P. Stevens, pp. 65-74.

Hasif, E. (1978). 'L'emploi de la traction animale dans les exploitations agricoles." Paper given at CILSS/IER meeting, February. Bamako, IER.

Haswell, M. R. (1953). Economics of Agriculture in a Savannah Village: Report on Three Years Study in Genieri Village and Its Lands; The Gambia. London, Her Majesty's Stationary Office, Colonial Research Study No. 8.

_____. (1975). The Nature of Poverty. London, Macmillan.

Hayami, Y., and V. W. Ruttan. (1971). Agricultural Development: An International Perspective. Baltimore, Johns Hopkins Univ. Press.

Hays, H. M. (1975). The Marketing and Storage of Food Grains in Northern Nigeria. Zaria, Nigeria, Ahmadu Bello Univ., IAR, Samaru Misc. Paper No. 50.

Hays, H. M., and J. H. McCoy. (1978). "Food Grain Marketing in Northern Nigeria: Spatial and Temporal Performance." J. Development Studies 14(2):182-192.

Hays, H. M., and A. K. Raheja. (1977). "Economics of Sole Crop Cowpea Production in Nigeria at the Farmers' Level Using Improved Practices." Experimental Agriculture 13(2):149-154.

Hazlewood, A. (1975). Economic Integration: The East African Experience. London, Heinemann.

_____. (1978). "Kenya: Income Distribution and Poverty--An Unfashionable View." J. Modern African Studies 16:81-96.

_____. (1979). "The End of the East African Community: What Are The Lessons for Regional Integration Schemes?" J. Common Market Studies 18(1):40-58.

Hazlewood, A., and I. Livingstone. (1978). "Complementarity and Competitiveness of Large- and Small-Scale Irrigated Farming: A Tanzanian Example." Oxford Bulletin Econ. and Stat. 40(3):195-208.

Helland, J. (1980). Five Essays on the Study of Pastoralists and the Development of Pastoralism. Bergen, Norway, Univ. of Bergen, Social Anthropological Institute, Occasional Paper No. 20.

Helleiner, G. K., ed. (1964). "The Fiscal Role of the Marketing Boards in Nigerian Economic Development, 1947-61." Econ. J. 74:582-610.

_____. (1966a). Peasant Agriculture, Government and Economic Growth in Nigeria. Homewood, Illinois, Irwin.

_____. (1966b). "Typology in Development Theory: The Land Surplus Economy (Nigeria)." Food Research Institute Studies 6:181-194.

_____. (1968a). "Agricultural Export Pricing Strategy in Tanzania." East African J. Rural Development 1(1):1-17.

_____, ed. (1968b). Agricultural Planning in East Africa. Nairobi, East African Publishing House.

_____. (1972). "Socialism and Economic Development in Tanzania." J. Development Studies 8:183-204.

_____. (1975). "Smallholder Decision Making: Tropical African Evidence" in Agriculture in Development Theory, L. G. Reynolds, ed. New Haven, Yale Univ. Press, pp. 27-52.

Heller, P. (1979). "The Under-financing of Recurrent Development Costs." Finance and Development 16(1):38-42.

Henn, J. (1978). "Peasants, Workers and Capital: The Political Economy of Labour and Incomes in Cameroun." Ph.D. dissertation, Harvard Univ.

Herman, L. (1979). The Livestock and Meat Marketing System in Upper Volta: An Evaluation of Economic Efficiency. Ann Arbor, Univ. of Michigan, CRED, Livestock Production and Marketing in the Entente States of West Africa, Monograph No. 4.

Herskovitz, M. J. (1926). "The Cattle Complex in East Africa." Amer. Anthropologist 28:230-272, 361-380, 494-528, and 633-664.

Heyer, J. (1966). "Agricultural Development and Peasant Farming in Kenya." Ph.D. dissertation, Univ. of London.

_____. (1971). "A Linear Programming Analysis of Constraints on Peasant Farms in Kenya." Food Research Institute Studies 10:55-67.

_____. (1972). "An Analysis of Peasant Farm Production Under Conditions of Uncertainty." J. Agr. Econ. 23:135-146.

_____. (1981). "Agricultural Development Policy in Kenya from the Colonial Period to 1975" in Heyer, Roberts, and Williams, 1981, pp. 90-120.

Heyer, J.; D. Ireri; and J. Moris. (1971). Rural Development in Kenya. Nairobi, East African Publishing House.

Heyer, J.; J. K. Maitha; and W. M. Senga, eds. (1976). Agricultural Development in Kenya. Nairobi, Oxford Univ. Press.

Heyer, J.; P. Roberts; and G. Williams, eds. (1981). Rural Development in Tropical Africa. New York, St. Martin's Press.

Heyer, J., and J. K. Waweru. (1976). "The Development of the Small Farm Areas" in Heyer, Maitha, and Senga, 1976, pp. 187-221.

Higgins, B. (1959). Economic Development: Principles, Problems and Policies. New York, Norton.

Higgs, J. (1978). Land Settlement in Africa and the Near East--Some Recent Changes. Rome, FAO, (ARRD/CS/19).

Hill, P. (1963). The Migrant Cocoa Farmers of Southern Ghana: A Study in Rural Capitalism. Cambridge, Cambridge Univ. Press.

_____. (1966). "A Plea for Indigenous Economics: The West African Example." Econ. Dev. and Cultural Change 15(1):10-20.

_____. (1968). "The Myth of the Amorphous Peasantry: A Northern Nigerian Case Study." Nigerian J. Econ. Soc. Studies 10:239-261.

_____. (1970). Studies in Rural Capitalism in West Africa. Cambridge, Cambridge Univ. Press.

_____. (1972). Rural Hausa: A Village and Setting. Cambridge, Cambridge Univ. Press.

_____. (1975). "The West African Farming Household" in Goody, pp. 119-136.

_____. (1978). "Food-Farming and Migration From Fante Villages." Africa 48(3):220-229.

Hinchey, M. T., ed. (1978). Proceedings of the Symposium on Drought in Botswana, June 5 to 8, 1978. Gaborone, Botswana Society in collaboration with Clark Univ. Press.

Hirschman, A. O. (1977). "A Generalized Linkage Approach to Development, With Special Reference to Staples." Econ. Dev. and Cultural Change 25(supplement):67-98.

_____. (1981). "The Rise and Decline of Development Economics" in Essays in Trespassing: Economics to Politics and Beyond. New York, Cambridge Univ. Press, pp. 1-24.

Hitchcock, R. K. (1978). Kalahari Cattle Posts: A Regional Study of Hunter-Gatherers, Pastoralists, and Agriculturalists in the Western Sandveld Region, Central District, Botswana. 2 Vols. Gaborone, Botswana, Ministry of Local Government and Lands.

Hjort, A. (1979). Savanna Town: Rural Ties and Urban Opportunities in Northern Kenya. Stockholm, Univ. of Stockholm, Studies in Social Anthropology.

Hjort, A., and W. Ostberg. (1978). Farming and Herding in Botswana. Stockholm, SAREC.

Hoben, A. (1973). Land Tenure Among the Amhara of Ethiopia: The Dynamics of Cognatic Descent. Chicago, Univ. of Chicago Press.

Hodd, M. (1976). "Income Distribution in Kenya (1963-72)." J. Development Studies 12(3).

_____. (1978). "Income Distribution in Kenya: A Reply." J. Development Studies 14(3):375-377.

Hodd, M.; W. J. House; and T. Killick. (1978). "Income Distribution in Kenya: A Controversy Resolved." J. Development Studies 15(1):117.

Hodder, B. W., and U. I. Ukwu. (1969). Markets in West Africa: Studies of Markets and Trade Among the Yoruba and Ibo. Ibadan, Ibadan Univ. Press.

Hoffman, A.; J. G. Disney; A. Pinegar; and J. D. Cameron. (1974). "The Preservation of Some East African Freshwater Fish." Afr. J. Trop. Hydrobiology and Fisheries 3(1):1-14.

Hogendorn, J. (1975). "Economic Initiative and African Cash Farming: Pre-Colonial Origins and Early Colonial Development" in Duigan and Gann, pp. 283-328.

_____. (1977). "Vent-for-Surplus Theory and The Economic History of West Africa: A Reply." Savanna 6(2):196-199.

_____. (1978). Nigerian Groundnut Exports: Origins and Early Development. Zaria, Nigeria, Ahmadu Univ. Press.

Holdcroft, L. E. (1978). The Rise and Fall of Community Development in Developing Countries, 1950-65: A Critical Analysis and an Annotated Bibliography. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Paper No. 2.

Holtham, G., and A. Hazlewood. (1976). Aid and Inequality in Kenya: British Development Assistance to Kenya. London, Croom Helm.

Holtzman, J.; J. Staatz; and M. Weber. (1980). An Analysis of Livestock Production and Marketing Subsystems in the Northeast Province of Cameroon. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Working Paper No. 11.

Honeybone, D., and A. Marter. (1975). An Evaluation Study of Zambia's Farm Institutes and Farmer Training Centers. Lusaka, Univ. of Zambia, Rural Development Studies Bureau.

Hopcroft, P. N., and G. M. Ruigu. (1976). Dairy Marketing and Pricing in Kenya: Are Milk Shortages the Consequences of Droughts or Pricing Policies? Nairobi, Univ. of Nairobi, IDS Discussion Paper No. 237.

Hopkins, A. G. (1973). An Economic History of West Africa. New York, Columbia Univ. Press.

Hopkins, E. (1974). "Operation Groundnuts: Lessons from an Agricultural Extension Scheme." IDS Bulletin 5(4):59-66.

Hopkins, N. S. (1976). "Participatory Decision Making and Modern Cooperatives in Mali: Notes Toward A Prospective Anthropology" in Popular Participation in Social Change: Cooperatives, Collectives and Nationalized Industry, J. Nash, J. Dandler, and N. S. Hopkins, eds. The Hague, Mouton, pp. 99-111.

Horowitz, M. (1972). "Ethnic Boundary Maintenance Among Pastoralists and Farmers in the Western Sudan (Niger)." J. Asian and African Studies 7(1):104-114.

_____. (1977). "Les strategies adaptatives au Sahel avant et apres la secheresse" in Gallais, pp. 219-233.

House, W. J., and T. Killick. (1978). "Hodd on Income Distribution in Kenya: A Critical Note." J. Development Studies 14(3):370-374.

_____. (1980). Social Justice and Development Policy in Kenya's Rural Economy. Geneva, ILO, World Employment Research Program, Working Paper 31.

House, W. J., and H. Rempel. (1980). "The Determinants of Interregional Migration in Kenya." World Development 8(1):25-36.

Howard, R. (1978). Colonialism and Underdevelopment in Ghana. London, Croom Helm.

Howe, C. (1966). "The Use of Sample Household Expenditure Surveys in Economic Planning in East Africa." Oxford Bulletin Econ. and Stat. 28:199-209.

_____. (1968). "An Analysis of African Household Consumption and Behavior in Kenya and Uganda." East African Econ. Rev. 4:51-62.

Howell, J., ed. (1980). Borrowers and Lenders: Rural Financial Markets and Institutions in Developing Countries. London, Overseas Development Institute.

Hughes, C., and J. M. Hunter. (1970). "Disease and 'Development' in Africa." Soc. Sci. and Med. 3:443-493.

_____. (1972). "The Role of Technological Development in Promoting Disease in Africa" in Farvar and Milton, pp. 69-101.

Huizer, G., and B. Mannheim, eds. (1979). The Politics of Anthropology: From Colonialism and Sexism Toward A View From Below. The Hague, Mouton.

Humphrey, D. H. (1975). "Socio-Economic Aspects of Rural Development in Malawi: A Report of Some Survey Findings." East African J. Rural Development 8(1-2):46-60.

Humphrey, D. H., and H. S. Oxley. (1976). "Expenditure and Household Size Elasticities in Malawi: Urban-Rural Comparisons, Demand Projections and a Summary of East African Findings." J. Development Studies 12(2):252-269.

Humphreys, C. P., and S. R. Pearson. (1979-80). "Choice of Technique in Sahelian Rice Production." Food Research Institute Studies 17(3):235-277.

Hunt, D. M. (1975a). Growth Versus Equity: An Examination of the Distribution of Economic Status and Opportunity in Mbere, Eastern Kenya. Nairobi, Univ. of Nairobi, IDS Occasional Paper No. 11.

_____. (1975b). "The Introduction of Single Axle Tractors on Peasant Coffee Farms in Masaka Division, Southern Uganda." Eastern Africa J. Rural Development 8:246-264.

_____. (1976). Chayanov's Model of Peasant Household Resource Allocation and Its Relevance to Mbere Division, Eastern Kenya. Nairobi, Univ. of Nairobi, IDS, Working Paper No. 276.

Hunter, J. M. (1967). "Seasonal Hunger in a Part of the West African Savanna: A Survey of Bodyweights in Nangodi, North East Ghana." Institute of British Geographers, Transactions 41:167-183.

_____. (1981). "Progress and Concerns in the World Health Organization Onchocerciasis Control Program in West Africa." Soc. Sci. Med. 15D:261-275.

Hunter, J. M., and G. K. Ntiri. (1978). "Speculations on the Future of Shifting Agriculture in Africa." J. Developing Areas 12(2):183-208.

Hutton, C. (1973). Reluctant Farmers? A Study of Unemployment and Planned Rural Change in Uganda. Nairobi, East African Publishing House.

Hutton, C., and R. Cohen. (1975). "African Peasants and Resistance to Change: A Reconsideration of Sociological Approaches" in Oxaal, Barnett, and Booth, pp. 105-130.

Hyden, G. (1973a). Agricultural Credit in Three Village Areas in North-Eastern Tanzania: A Case Study. Rome, FAO, Agricultural Credit Case Study, Working Paper No. 2.

_____. (1973b). Efficiency Versus Distribution in East African Cooperatives: A Study in Organizational Conflicts. Nairobi, East African Literature Bureau.

_____. (1978/79). "Cooperatives and Local Leadership Patterns." Rural Africana 3:43-59.

_____. (1980). Beyond Ujamaa in Tanzania: Under-Development and an Uncaptured Peasantry. Berkeley, Univ. of California Press.

Hymer, S., and S. Resnick. (1969). "A Model of an Agrarian Economy With Non-Agricultural Activities." Amer. Econ. Rev. 59:493-506.

IADS. (1979). Senegal Agricultural Research Project. New York, Report of a Senegalese-International Agricultural Development Service Team Report to the General Delegation for Scientific and Technical Research (DGRST). Dakar, Senegal.

ICRISAT. (1980a). Proceedings of the International Workshop on Socioeconomic Constraints to Development of Semi-Arid Tropical Agriculture, 19-23 February 1979, Hyderabad, India. Patancheru, India, ICRISAT.

_____. (1980b). Proceedings of the International Workshop on Sorghum Diseases, 11-15 December, 1978, Hyderabad, India. Patancheru, India, ICRISAT.

_____. (1980c). Annual Report, 1980. Ouagadougou, Republic of Upper Volta, Ministry of Rural Development.

Idachaba, F. S. (1973). "Marketing Board Crop Taxation and Input Subsidies: A Second-Best Approach." Nigerian J. Econ. Soc. Studies 15:317-324.

_____. (1977). "Pesticide Input Subsidies in African Agriculture: The Nigerian Experience." Canadian J. Agr. Econ. 25:88-103.

_____. (1980a). Agricultural Research Policy in Nigeria. Washington, IFPRI.

_____. (1980b). "Food Policy in Nigeria: Towards a Framework of Analysis." Agricultural Research Bulletin 1(1):1-47.

_____. (1981). Farm Input Subsidies for the Green Revolution in Nigeria: Lessons from Experience. Ibadan, Nigeria, Univ. of Ibadan, Dept. of Agr. Econ., Food Policy Technical Paper No. 2.

Idachaba, F. S.; J. A. Akinwumi; C. E. Olumese; L. O. Ologide; S. A. Adetunji; and T. A. Taylor; eds. (1981). The Crop Subsector in the Fourth National Development Plan, 1981-85 (Proceedings of a Workshop organized by the Federal Department of Agriculture, August 29-30, 1979). Lagos, Nigeria, Federal Dept. of Agr.

Idusogie, E. O. (1969). "A Critical Review of the Role of Cash Cropping on the Nutrition of Nigerian Peoples." Unpublished Ph.D. dissertation, Univ. of London.

IEMVT. (1980). Elements for a Livestock Development Strategy in Sahel Countries. Paris, OECD, Club du Sahel.

IITA/SAFGRAD. (1980). SAFGRAD and IDRC-Upper Volta National Cowpea Improvement Program; Report 1979. Ouagadougou, Upper Volta, IITA.

ILCA. (1978). Evaluation of the Productivities of Maure and Peul Cattle Breeds at the Sahelian Station, Niono, Mali. Addis Ababa, ILCA, Monograph No. 1.

_____. (1979a). Small Ruminant Production in the Humid Tropics. Addis Ababa, ILCA, Systems Study No. 3.

_____. (1979b). Livestock Production in the Sub-humid Zone of West Africa: A Regional Review. Addis Ababa, ILCA, Systems Study No. 2.

_____. (1979c). Trypanotolerant Livestock in West and Central Africa. 2 vols. Addis Ababa, ILCA, Monograph No. 2.

_____. (1979d). Towards an Economic Assessment of Veterinary Inputs in Tropical Africa. Addis Ababa.

_____. (1980a). Pastoral Development Projects. Addis Ababa, ILCA Bulletin No. 9.

_____. (1980b). Economic Aspects of Browse Development. Addis Ababa, ILCA Bulletin No. 11.

Iliffe, J. (1979). Modern History of Tanganyika. Cambridge Univ. Press.

ILO. (1970). Socio-Economic Conditions in the Ifo, Otta and Ilaro Districts of the Western State of Nigeria. Geneva, ILO Fact-Finding Report for the Pilot Project for Rural Employment Promotion in the Western State.

_____. (1972). Employment, Incomes and Equality: A Strategy for Increasing Productive Employment in Kenya. Geneva.

_____. (1976). Growth, Employment and Equity: A Comprehensive Strategy for the Sudan. Geneva.

_____. (1981). First Things First: Meeting the Basic Needs of the People of Nigeria. Addis Ababa, Ethiopia, ILO, Job and Skills Program for Africa, Report to the Government of Nigeria by a JASPA Basic Needs Mission.

Ingle, C. R. (1972). From Village to State in Tanzania: The Politics of Rural Development. Ithaca, Cornell Univ. Press.

Institut d' Economie Rurale. (1977). Pour une programme de recherche sur les systems de production agricole. Bamako, Institut d' Economie Rurale.

International Bank for Reconstruction and Development. (1961). The Economic Development of Tanganyika. Baltimore, Johns Hopkins Univ. Press for the IBRD.

IRAT. (1980). Campagne, 1979. Resume des travaux, Conclusions. Ouagadougou, Upper Volta.

Irvine, F. R. (1969). West African Agriculture. Vol. 2: West African Crops. London, Oxford Univ. Press.

Isaacman, A. (1979). "Transforming Mozambique's Rural Economy." Rural Africana (New Series) 4-5:97-113.

ISRA. (1977). Recherche et developpment agricole: les unites experimentales du Senegal: compte rendu du seminaire tenu au CNRA de Bambey du 16 au 21 mai 1977. Dakar, Senegal.

Issard, W. (1979). Rural-Urban Migration of Women in Botswana. Gaborone, Ministry of Finance, Central Statistical Office, National Migration Study.

Ita, E. O. (1975). "A Conceptualized Fishing System for the African Environment with a Comparative Approach." African J. Trop. Hydrobiology and Fisheries 4(1):141-147.

Jabara, C. L., and R. L. Thompson. (1980). "Agricultural Comparative Advantage Under International Price Uncertainty: The Case of Senegal." Amer. J. Agr. Econ. 62(2):188-198.

Jackson, I. C. (1956). Advance in Africa: A Study of Community Development in Eastern Nigeria. London, Oxford Univ. Press.

Jackson, J. A. (1969). Migration. London, Cambridge Univ. Press.

Jackson, P. B. N. (1971). "The African Great Lakes Fisheries: Past, Present and Future." African J. Trop. Hydrobiology and Fisheries 1(1):35-49.

Jacobs, A. H. (1975). "Maasai Pastoralism in Historical Perspective" in Monod, pp. 406-425.

_____. (1978). Development in Tanzania Maasailand: The Perspective Over 20 Years, 1957-1977. Dar es Salaam, USAID.

Jahnke, H. E. (1974). The Economics of Controlling Tsetse Flies and Cattle Trypanosomiasis in Africa Examined for the Case of Uganda. Munich, West Germany, Weltforum Verlag, No. 48.

Jain, S. (1975). Size Distribution of Income: A Compilation of Data. Washington, World Bank.

Jarvis, L. S. (1974). "Cattle as Capital Goods and Ranchers as Portfolio Managers: An Application to the Argentine Cattle Sector." J. Polit. Econ. 82(3):489-520.

_____. (1980). "Cattle as a Store of Wealth in Swaziland: Comment." Amer. J. Agr. Econ. 62(3):606-613.

Johnson, A. W. (1972). "Individuality and Experimentation in Traditional Agriculture." Human Ecology 1:149-159.

Johnson, G. (1971). "The Structure of Rural-Urban Migration Models." East African Econ. Rev. 3:21-28.

Johnson, G., and W. E. Whitlaw. (1974). "Urban-Rural Income Transfers in Kenya: An Estimated Remittance Function." Econ. Dev. and Cultural Change 22:473-479.

Johnson, G. L. (1968). "Removing Obstacles to the Use of Genetic Breakthrough in Oil Palm Production: The Nigerian Case" in National Research Council, 1968, Vol. II, pp. 365-375.

Johnson, G. L.; O. J. Scoville; G. K. Dike; and C. K. Eicher. (1969). Strategies and Recommendations for Nigerian Rural Development, 1969/85. East Lansing, Michigan State Univ., Dept. of Agr. Econ., Consortium for the Study of Nigerian Rural Development, CSNRD 33.

Johnson, H. G. (1967). Economic Policies Toward Less Developed Countries. Washington, The Brookings Institution.

Johnston, B. F. (1958). The Staple Food Economies of Western Tropical Africa. Stanford, California, Stanford Univ. Press.

_____. (1964). "The Choice of Measures for Increasing Agricultural Productivity: A Survey of Possibilities in East Africa." Tropical Agr. 40(2):91-113.

Johnston, B. F., and W. Clark. (1982). Redesigning Rural Development: A Strategic Perspective. Baltimore, Johns Hopkins Univ. Press.

Jones, M. J. (1973). A Review of the Use of Rock Phosphate Fertilizers in Francophone West Africa. Zaria, Ahmadu Bello Univ., IAR, Samaru Misc. Paper No. 43.

Jones, M. J., and A. Wild. (1975). Soils of the West African Savanna. Farnham Royal, England, Commonwealth Agricultural Bureau.

Jones, R. A., and R. J. Robinson. (1976). "Income Distribution and Development: Rhodesia and Malawi Compared." Rhodesian J. Econ. 10:91-102.

Jones, W. I. (1972). "The Mise and Demise of Socialist Institutions in Rural Mali." Geneva-Africa 11(2):19-44.

_____. (1976). Planning and Economic Policy: Socialist Mali and Her Neighbors. Washington, Three Continents Press.

Jones, W. O. (1959). Manioc in Africa. Stanford, California, Stanford Univ. Press.

_____. (1960). "Economic Man in Africa." Food Research Institute Studies I:107-134.

_____. (1972). Marketing Staple Foods in Tropical Africa. Ithaca, Cornell Univ. Press.

_____. (1974). "Regional Analysis and Agricultural Marketing Research in Tropical Africa: Concepts and Experience." Food Research Institute Studies 13:3-28.

_____. (1980a). "Agricultural Trade Within Tropical Africa: Historical Background" in Bates and Lofchie, 1980, pp. 10-45.

_____. (1980b). "Agricultural Trade Within Tropical Africa: Achievements and Difficulties" in Bates and Lofchie, 1980, pp. 311-348.

Joy, L. (1967). "The Economics of Food Production." African Affairs 65:317-327.

Joyce, S., and F. Beudot. (1976/77). Elements for a Bibliography of the Sahel Drought. Vol. 1 (1976) and Vol. 2 (1977). Paris, OECD, Development Center.

Jurion, F., and J. Henry. (1969). Can Primitive Farming Be Modernized? Translated from the French by AGRA Europe. Brussels, SERDAT.

Kaberry, P. M. (1952). Women of the Grassfields: A Study of the Economic Position of Women in Bamenda, British Cameroons. London, Her Majesty's Stationery Office.

Kafando, T. W. (1972). Contribution a l'etude du developpement integre du Liptako-Gourma: Introduction a l'etude des systemes agro-pastoraux. Dakar, Senegal, IDEP.

Kamajou, F., and C. Baker. (1980). "Reforming Cameroon's Government Credit Programs: Effects on Liquidity Management by Small Farm Borrowers." Amer. J. Agr. Econ. 62(4):709-718.

Kamarck, A. M. (1976). The Tropics and Economic Development: A Provocative Inquiry Into the Poverty of Nations. Baltimore, Johns Hopkins Univ. Press.

Kamuanga, M. (1981). "Farm Level Study of the Rice Production System at the Office du Niger in Mali: An Economic Analysis." Ph.D. dissertation, Michigan State Univ.

Kamuanga, M., and D. S. C. Spencer. (1981). Losses of Rice in West Africa: The Case of the Office du Niger in Mali. Monrovia, Liberia, WARDA, Occasional Paper No. 5.

Kassam, A. H. (1976). Crops of the West African Semi-Arid Tropics. Hyderabad, India, ICRISAT.

Kassam, A. H., and D. J. Andrews. (1975). "Effects of Sowing Date on Growth, Development and Yield of Photosensitive Sorghum at Samaru, Northern Nigeria." Experimental Agriculture 11:227-240.

Kay, G. B. (1972). The Political Economy of Colonialism in Ghana: A Collection of Documents and Statistics, 1900-1960. Cambridge, Cambridge Univ. Press.

Kearl, B., ed. (1976). Field Data Collection in the Social Sciences: Experiences in Africa and the Middle East. New York, ADC.

Keller, W.; E. Muskat; and E. Valder. (1969). "Some Observations Regarding Economy, Diet and Nutritional Status of Kikuyu Farmers in Kenya" in Kraut and Cremer, pp. 241-266.

Kenya, Colony and Protectorate of. (1954). A Plan to Intensify the Development of African Agriculture in Kenya (Swynnerton Plan). Nairobi, Government Printer.

Kenya, Republic of. (1965). African Socialism and Its Application to Planning in Kenya. Nairobi, Government Printer.

_____. (1973). Sessional Paper No. 10 of 1973 on Employment. Nairobi, Government Printer.

_____. (1979a). Child Nutrition in Rural Kenya. Nairobi, Ministry of Economic Planning and Community Affairs, Central Bureau of Statistics.

_____. (1979b). Development Plan, 1979-83. Part I. Nairobi, Government Printer.

Ker, A. D. R. (1973). "The Development of Improved Farming Systems Based on Ox-Cultivation" in Amann, 1973.

Keregero, K. J. B.; J. de Vries; and C. D. S. Bartlett. (1976). Farmer Resistance to Extension Advice: Who Is To Blame? A Case Study of Cotton Production in Mara Region, Tanzania. Morogoro, Tanzania, Univ. of Dar es Salaam, Dept. of Agr. Econ., Rural Economy Review Paper No. 5.

Kgarebe, A., ed. (1981). SADCC 2-Maputo. The Proceedings of the Second Southern African Development Co-ordination Conference, Maputo, People's Republic of Mozambique, 27/28 November 1980. London, SADCC Liaison Committee.

Khalifa, A. H., and M. C. Simpson. (1972). "Perverse Supply in Nomadic Societies." Oxford Agrarian Studies 1:46-56.

Kilby, P. (1961). "African Labor Productivity Reconsidered." Econ. J. 71:273-291.

_____. (1962). The Development of Small Industry in Eastern Nigeria. Lagos, Nigeria, USAID.

_____. (1965). "Patterns of Bread Consumption in Nigeria." Food Research Institute Studies 5:3-18.

_____. (1967). "The Nigerian Oil Palm Industry." Food Research Institute Studies 7(2):177-204.

_____. (1968). "The Nigerian Oil Palm Industry: A Reply." Food Research Institute Studies 8(1):199-203.

_____. (1969). Industrialization in an Open Economy: Nigeria, 1945-66. Cambridge, Cambridge Univ. Press.

Killick, T. (1976a). The Economies of East Africa: A Bibliography. Boston, G. K. Hall.

_____. (1976b). "The Possibilities of Economic Planning." Oxford Economic Papers 28:161-184.

_____. (1978). Development Economics in Action: A Study of Economic Policies in Ghana. New York, St. Martins Press.

_____. (1980). "Trends in Development Economics and Their Relevance to Africa." J. Modern African Studies 18(3):367-386.

King, K. (1977). The African Artisan: Education and the Informal Sector in Kenya. London, Heinemann.

King, R. (1975). "Experiences in the Administration of Cooperative Credit and Marketing Societies in Northern Nigeria." Agricultural Admin. 2:195-208.

_____. (1981). "Cooperative Policy and Village Development in Northern Nigeria" in Heyer, Roberts, and Williams, pp. 259-280.

King, R. P., and D. Byerlee. (1978). "Factor Intensities and Locational Linkages of Rural Consumption Patterns in Sierra Leone." Amer. J. Agr. Econ. 60:197-206.

Kinsey, B. H. (1976). Economic Research and Farm Machinery Design in Eastern Africa. Norwich, England, Univ. of East Anglia, Development Studies Discussion Paper No. 10.

_____. (1978). "Agricultural Technology and Rural Development in the Rainfed Maize Area of Southeastern Zambia." Ph.D. dissertation, Stanford Univ.

Kiss, J. (1977). Will Sudan Be An Agricultural Power? Budapest, Hungarian Academy of Sciences, Institute for World Economics.

Kitching, G. (1980). Class and Economic Change in Kenya: The Making of an African Petite Bourgeoise, 1905-1970. New Haven, Conn., Yale Univ. Press.

Kleemeier, L. L. (1978). "Empirical Tests of Dependency Theory: A Second Critique of Methodology." J. Modern African Studies 16(3):701-704.

Kleene, P. (1976). "Notion d'exploitation agricole et modernization en milieu Wolof-Saloum (Senegal)." L'Agronomie Tropicale 31:63-82.

Klein, M. A., ed. (1980). Peasants in Africa: Historical and Contemporary Perspectives. Beverly Hills, California, Sage.

Kline, C. K.; D. A. G. Green; R. L. Donahue; and B. A. Stout. (1969). Agricultural Mechanization in Equatorial Africa. East Lansing, Michigan State Univ., Institute of International Agriculture, Research Report No. 9.

Kloth, T. I.; W. A. Burr; J. P. Davis; G. Epler; C. A. Kolff; R. I. Rosenberg; N. W. Staehling; J. M. Lane; and M. H. Nichaman. (1976). "Sahel Nutrition Survey, 1974." Amer. J. Epidemiology 103(4):383-390.

Knight, J. B. (1972). "Rural-Urban Income Comparisons and Migration in Ghana." Oxford Bulletin Econ. and Stat. 34:199-228.

_____. (1976). "Explaining Income Distribution in Less Developed Countries: A Framework and an Agenda." Oxford Bulletin Econ. and Stat. 38:161-177.

Knight, J. B., and G. Lenta. (1980). "Has Capitalism Underdeveloped the Labor Reserves of South Africa?" Oxford Bulletin Econ. and Stat. 42(3)157-201.

Knowles, J. C., and R. Anker. (1981). "An Analysis of Income Transfers in a Developing Country: The Case of Kenya." J. Development Economics 8(2):205-226.

Kocher, J. E. (1979). Rural Development and Fertility Change in Tropical Africa: Evidence From Tanzania. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Paper No. 19.

Kocher, J. E., and B. Fleisher. (1979). A Bibliography on Rural Development in Tanzania. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Paper No. 3.

Kofi, T. A. (1972). "International Commodity Agreements and Export Earnings: Simulation of the 1968 'Draft International Cocoa Agreement'." Food Research Institute Studies 11:177-201.

Kohler, J. M. (1971). Activites agricoles et changements sociaux dans l'Ouest-Mossi (Haute-Volta). Paris, ORSTOM, Memoires ORSTOM No. 46.

_____. (1972). Les migrations des Mossi de l' Ouest (Haute-Volta). Paris, ORSTOM.

Kolasa, K. M. (1980). "The Nutritional Situation in Sierra Leone." Rural Africana 7:55-68.

Kolawole, M. I. (1972). "An Application of Queuing Theory to Tractor Contracting Operations in Western Nigeria." Bulletin Rural Econ. and Sociology 7:155-185.

_____. (1974). "Economic Aspects of Private Tractor Operations in the Savanna Zone of Western Nigeria." Savanna 3(2):175-183.

Kollberg, S. (1979). East African Marine Research and Marine Resources. Stockholm, SAREC.

Konczacki, Z. A. (1978). The Economics of Pastoralism: A Case Study of Sub-Saharan Africa. London, Cass.

Korte, R. (1969). "The Nutritional and Health Status of the People Living on the Mwea-Tebere Irrigation Settlement" in Kraut and Cremer, pp. 267-334.

Kostinko, G., and J. Dione. (1980). Rural Development in Senegal: An Annotated Bibliography. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Paper No. 23.

Kotey, R. A.; C. Okali; and B. E. Rourke, eds. (1974). The Economics of Cocoa Production and Marketing: Proceedings of Cocoa Economics Research Conference, Legon, April 1973. Legon, Univ. of Ghana, ISSER.

Kowal, J. M., and A. H. Kassam. (1978). Agricultural Ecology of Savanna: A Study of West Africa. Oxford; New York, Clarendon Press.

Kraut, H., and H. D. Cremer, eds. (1969). Investigations Into Health and Nutrition in East Africa. New York, Humanities Press.

Kriesel, H. C.; C. K. Laurent; C. Halpern; and H. E. Larzelere. (1970). Agricultural Marketing in Tanzania: Background Research and Policy Proposals. East Lansing, Michigan State Univ., Dept. of Agr. Econ.

Krone, W. (1970). Frozen Fish Marketing in West African Countries--A Case Study in Fish Marketing Development. Rome, FAO Fisheries Report No. 96.

Kudhongania, A. W., and A. J. Cordone. (1974). "Past Trends, Present Stocks and Possible Future State of the Fisheries of the Tanzania Part of Lake Victoria." African J. Trop. Hydrobiology and Fisheries 3(2):167-181.

Kuper, H., ed. (1965). Urbanization and Migration in West Africa. Berkeley and Los Angeles, Univ. of California Press.

Kuznets, S. (1955). "Economic Growth and Income Inequality." Amer. Econ. Rev. 45:1-28.

_____. (1976). "Demographic Aspects of the Size Distribution of Income: An Exploratory Essay." Econ. Dev. and Cultural Change 25(1):1-94.

Labonne, M., and B. Legagneux. (1977). Reflexions sur l' agriculture Senegalaise: etude prealable a une modelisation. Montpellier, France, Ecole Nationale Superieure Agronomique.

La Clau, E. (1971). "Feudalism and Capitalism in Latin America." New Left Rev. (67):19-38.

Lagemann, J. (1977). Traditional African Farming Systems in Eastern Nigeria: An Analysis of Reaction to Increasing Population Density. Munich, West Germany, Weltforum Verlag.

Lagemann, J.; J. C. Flinn; and H. Ruthenberg. (1976). "Land Use, Soil Fertility and Agricultural Productivity as Influenced by Population Density in Eastern Nigeria." Zeitschrift fur Auslandische Landwirtschaft 5(2):206-219.

Lancaster, C. W. (1976). "Women, Horticulture and Society in Sub-Saharan Africa." Amer. Anthropologist 78:539-564.

Lang, H. (1979). The Economics of Rainfed Rice Cultivation in West Africa: The Case of the Ivory Coast. Saarbrucken, West Germany, Verlag Breitenbach.

Lang, H., and R. Bartsch. (1977). "Evaluation de l'interet economique de methodes culturales ameliorees en conditions d'incertitude climatique presentee a l'exemple de la region Centre en Cote-d'Ivoire." L'Agronomie Tropicale 32(3):248-256.

Lassiter, G. C. (1981). Cropping Enterprises in Eastern Upper Volta. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 35.

Lateef, N. V. (1980). Crisis in the Sahel: A Case Study in Development Cooperation. Boulder, Colorado, Westview Press.

Latham, M. C. (1980). Human Nutrition in Tropical Africa. Rome, FAO.

Laurent, C. K. (1968). "The Use of Bullocks for Power on Farms in Northern Nigeria." Bulletin Rural Econ. and Sociology 3:235-262.

Lawani, S. M.; F. M. Alluri; and E. N. Adimorah. (1979). Farming Systems in Africa: A Working Bibliography, 1930-1978. Boston, G. K. Hall.

Lawani, S. M., and M. O. Odubanjo. (1976). A Bibliography of Yams and the Genus Dioscorea. Ibadan, Nigeria, IITA.

Leakey, C. L. A., ed. (1970). Crop Improvement in East Africa. Farnham Royal, England, Commonwealth Agricultural Bureau.

Leakey, C. L. A., and J. B. Wills, eds. (1977). Food Crops of the Lowland Tropics. Oxford, Oxford Univ. Press.

Le Bris, E.; P-P. Rey; and M. Samuel. (1976). Capitalisme negrier: la marche des paysans la marche de paysans vers le proletariat. Paris, Maspero.

Lee, E. (1980). Export-Led Rural Development: The Ivory Coast. Geneva, ILO, World Employment Research Program, Working Paper 32.

Lele, U. (1975). The Design of Rural Development: Lessons From Africa. Baltimore, Johns Hopkins Univ. Press.

_____. (1977). "Considerations Related to Optimum Pricing and Marketing Strategies in Rural Development" in Dams and Hunt, pp. 488-516.

_____. (1981). "Rural Africa: Modernization, Equity and Long-Term Development." Science 211:547-553.

Lele, U., and W. Candler. (1981). "Food Security: Some East African Considerations" in Valdes, pp. 102-122.

Le Moigne, M. (1980). "Animal Draft Cultivation in French-Speaking Africa" in ICRISAT, 1980a, pp.213-220.

Leonard, D. K., ed. (1973). Rural Administration in Kenya; A Critical Appraisal. Nairobi, East African Literature Bureau.

Leonard, D. K. (1977). Reaching the Peasant Farmers: Organization Theory and Practice in Kenya. Chicago, Univ. of Chicago Press.

Lesthaeghe, R.; P. O. Ohadike; J. Kocher; and H. J. Page. (1981). "Child-Spacing and Fertility in Sub-Saharan Africa: An Overview of Issues" in Child Spacing in Tropical Africa: Tradition and Change, H. J. Page and R. Lesthaeghe, eds. New York, Academic Press, pp. 3-23.

Leurquin, P. P. (1960). Le niveau de vie des populations rurales du Ruanda- Urundi. Paris, Editions Nauwelaerts.

Lev, L. (1981). "The Effect of Cash Cropping on Food Consumption Adequacy Among the Meru of Northern Tanzania." M.Sc. Thesis, Michigan State Univ.

Lever, B. G. (1970). Agricultural Extension in Botswana. Reading, Univ. of Reading, Dept. of Agr. Econ., Development Study No. 7.

Lewis, I. M. (1975). "The Dynamics of Nomadism: Prospects for Sedentarization and Social Change" in Monod, pp. 426-442.

Lewis, J. V. D. (1978). "Small Farmer Credit and the Village Production Unit in Rural Mali" in P. Stevens, Jr., pp. 29-48.

Lewis, W. A. (1954). "Economic Development with Unlimited Supplies of Labor." The Manchester School 22:132-191.

_____. (1964). "Thoughts on Land Settlement" in Eicher and Witt, pp. 299-310.

_____. (1978a). "Socialism and Economic Growth" in Research on Economic Anthropology, Vol. 1, G. Dalton, ed., pp. 325-338. Greenwich, Ct., JAI Press.

_____. (1978b). The Evolution of the International Economic Order. Princeton, N.J., Princeton Univ. Press.

Lewycky, D. (1977). Tapestry--Report from Oodi Weavers. Gaborone, Botswana, National Institute for Research in Development and African Studies.

Leys, C. (1973). "Interpreting African Underdevelopment: Reflections on the ILO Report on Employment, Incomes and Equity in Kenya." African Affairs 72:419-429.

_____. (1974). Underdevelopment in Kenya: The Political Economy of Neo-Colonialism, 1964-71. Berkeley, Univ. of California Press.

Liedholm, C. (1973). Research on Employment in the Rural Non-Farm Sector in Africa. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Paper No. 5.

Liedholm, C., and E. Chuta. (1976). The Economics of Rural and Urban Small-Scale Industries in Sierra Leone. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Paper No. 14.

Lijoodi, J. L., and H. Ruthenberg. (1978). "Income Distribution in Kenya's Agriculture." Zeischrift fur Auslandische Landwirtschaft 17(2):115-128.

Linsenmeyer, D. A. (1976). Economic Analysis of Alternative Strategies for the Development of Sierra Leone Marine Fisheries. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 18.

Lipton, M. (1978). Botswana: Employment and Labour Use in Botswana. 2 Vols. Gaborone, Botswana, Government Printer.

_____. (1980). "Migration from Rural Areas of Poor Countries: The Impact on Rural Productivity and Income Distribution." World Development 8(1):1-24.

Livingstone, I. (1977a). "An Evaluation of Kenya's Rural Industrial Development Programme." J. Modern African Studies 15:495-504.

_____. (1977b). Economic Irrationality Among Pastoral Peoples in East Africa: Myth or Reality. Nairobi, Univ. of Nairobi, IDS Discussion Paper No. 245.

_____. (1977c). "Supply Responses of Peasant Producers: The Effect of Own-Account Consumption on the Supply of Marketed-Output." J. Agr. Econ. 28:153-159.

Lofchie, M. F. (1975). "Political and Economic Origins of African Hunger." J. Modern African Studies 13:551-568.

_____. (1978). "Agrarian Crisis and Economic Liberalisation in Tanzania." J. Modern African Studies 16(3):451-475.

Lombin, G., and A. Abdullahi. (1977). Long-Term Fertility Studies at Samaru, Nigeria. I. Effect of Farm-Yard Manure on Monocropped Cotton, Sorghum and Groundnuts and a Rotation of the Three Crops Under Continuous Cultivation. Zaria, Nigeria, Ahmadu Bello Univ., IAR, Samaru Misc. Paper 72.

Long, N. (1974). An Introduction to the Sociology of Rural Development. Boulder, Colorado, Westview Press.

Longhurst, R., and P. R. Payne. (1979). Seasonal Aspects of Nutrition: Review of Evidence and Policy Implications. Sussex, Univ. of Sussex, IDS Discussion Paper 145.

Lovejoy, P. (1980). Caravans of Kola: The Hausa Kola Trade, 1700-1900. Zaria, Ahmadu Bello Univ. Press.

Lovejoy, P. E., and S. Baier. (1975). "The Desert-Side Economy of the Central Sudan." International J. African History Studies 8(4):551-581.

Low, A. R. C. (1974). "Decision Taking Under Uncertainty: A Linear Programming Model of Peasant Farmer Behaviour." J. Agr. Econ. 25:311-321.

_____. (1978). "Linear Programming and the Study of Peasant Farming Situations--A Reply." J. Agr. Econ. 29:189-190.

_____. (1980). The Estimation and Interpretation of Pastoralists' Price Responsiveness. London, ODI, Pastoral Network Paper No. 10c.

Low, A. R. C., and R. L. Kemp. (1977). "Destocking Dynamics: The Implications of a Swaziland Example." Oxford Agrarian Studies 6:26-43.

Low, A. R. C.; R. L. Kemp; and M. H. Doran. (1980). "Cattle as a Store of Wealth: Reply." Amer. J. Agr. Econ. 62(3):613-617.

Luning, H. A. (1967). Economic Aspects of Low Labour-Income Farming. Wageningen, Netherlands, Centre for Agricultural Publications and Documentation, Agricultural Research Report No. 699.

Lynch, S. G. (1980). An Analysis of Interview Frequency and Reference Period in Rural Consumption Expenditure Surveys: A Case Study from Sierra Leone. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Working Paper No. 10.

MacArthur, J. D. (1968). "Experience with Farm Management Analysis Techniques in Kenya." East African J. Rural Development 1(2):22-32.

_____. (1975). "Benefits of Hindsight: Aspects of Experience in the High and Low Density Settlement Programme in Kenya." East African J. Rural Development 8(1-2):1-45.

_____. (1978). "Appraising the Distributional Aspects of Rural Development Projects: A Kenya Case Study." World Development 6:167-194.

MacKenzie, W. (1976). "The Livestock Development Program in Tanzania: Phase II." Eastern Africa J. Rural Development 9(1-2):92-115.

McCown, R. L.; G. Haaland; and C. De Haan. (1979). "The Interaction Between Cultivation and Livestock Production in Semi-Arid Africa" in Agriculture in Semi-Arid Environments, A. E. Hall, G. H. Cannel, and H. W. Lawton, eds. New York, Springer-Verlag, pp. 297-332.

McDowall, M. (1976). Lesotho Labour in South African Mines. Johannesburg, Agency for Industrial Mission, Agency for Industrial Mission Conference Report.

McDowell, R. E. (1972). The Improvement of Livestock Production in Warm Climates. San Francisco, W. H. Freeman and Co.

_____. (1978). "Feed Resources of Small Farms." Paper presented at a Seminar on Improvement of Farming Systems, 20 February-1 March 1978. Bamako, Mali, IER.

McDowell, R. E., and L. Bove. (1977). The Goat as a Producer of Meat. Ithaca, Cornell Univ., International Agriculture, Mimeograph No. 56.

McDowell, R. E., and P. E. Hildebrand. (1980). Integrated Crop and Animal Production: Making the Most of Resources Available to Small Farms in Developing Countries. New York, Rockefeller Foundation.

McGowan, P. J. (1976). "Economic Dependency and Economic Performance in Black Africa." J. Modern African Studies 14(1):25-40.

McHenry, Dean E., Jr. (1979). Tanzania's Ujamaa Villages: The Implementation of a Rural Development Strategy. Berkeley, California, Univ. of California, Institute of International Studies.

_____. (1981). Ujamaa Villages in Tanzania: A Bibliography. Uppsala, Scandinavian Institute of African Studies.

McIlwaine, J. H. (1979). Theses on Africa, 1963-1975, Accepted by Universities in the United Kingdom and Ireland. London, Mansell Information.

McKelvey, J. J., Jr. (1965). "Agricultural Research" in The African World: A Survey of Social Research, R. A. Lystad, ed. New York, Praeger, pp. 317-351.

McKim, W. (1972). "The Periodic Market System in Northeastern Ghana." Econ. Geography 48(3):333-344.

McLoughlin, P. F. M. (1967). Research on Agricultural Development in East Africa. New York, ADC.

_____, ed. (1970). African Food Production Systems: Cases and Theory. Baltimore, Johns Hopkins Univ. Press.

McPhee, A. (1971). The Economic Revolution of British West Africa. 2nd Ed. London, Frank Cass. (First edition, 1926.)

Maas, A., and R. L. Anderson. (1978). . . . And the Desert Shall Rejoice: Conflict, Growth and Justice in Arid Environments. Cambridge, Mass., The MIT Press.

Mabawonku, W. (1978). Economic Evaluation of Apprenticeship Training in Western Nigerian Small-Scale Industries. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Paper No. 17.

Mabogunje, A. L. (1972). Regional Mobility and Resource Development in West Africa. Montreal, McGill-Queen's Univ. Press.

_____. (1981). The Development Process: A Spatial Perspective. New York, Holmes and Meier.

Magasa, A. (1978). Papa-commandant a jete un grand filet devant nous. Les exploites des rives du Niger, 1900-1962. Paris, Maspero.

Maimbo, F. J. M., and J. Fry. (1971). "An Investigation Into the Change in the Terms of Trade Between the Rural and Urban Sectors of Zambia." African Social Res. 12:95-110.

Maitha, J. K. (1969). "A Supply Function for Kenyan Coffee." Eastern Africa Econ. Rev. 1:63-72.

_____. (1970). "Productivity Response to Price: A Case Study of Kenyan Coffee." Eastern Africa Econ. Rev. 2:31-37.

_____. (1974). "A Note on Distributed Lag Models of Maize and Wheat Production Response: The Kenyan Case." J. Agr. Econ. 25:183-188.

Manetsch, T. J.; M. L. Hayenga; A. N. Halter; T. W. Carroll; M. H. Abkin; D. R. Byerlee; K.-Y. Chang; G. Page; E. Kellogg; and G. L. Johnson. (1971). A Generalized Simulation Approach to Agricultural Sector Analysis with Special Reference to Nigeria. East Lansing, Michigan State Univ., Dept. of Agr. Econ.

Mansvelt-Beck, J., and J. J. Sterkenburg. (1976). The Fishing Industry in Cape Coast, Ghana: A Social-Economic Analysis of Fishing and Fish Marketing in a Medium-Sized African Town. Utrecht, Netherlands, Geografisch Institut Rijksuniversiteit Utrecht, Utrechtse Geografishe Studies No. 1.

Manteuffel, H. M., and W. E. Tyner. (1980). "Benefit-Cost Analysis of Small Irrigated Perimeters--A Sahelian Case Study" in Purdue Univ., 1980.

Marchal, J.-Y. (1977). "Evolution des systemes agraires: l'exemple du Yatenga (Haute-Volta)." Environnement Africain 2(4) and 3(1):75-88.

Marshall, A. (1956). Principles of Economics, An Introductory Volume, 8th ed. London, MacMillan.

Marter, A. (1978). Cassava or Maize: A Comparative Study of the Economics of Production and Market Potential of Cassava and Maize in Zambia. Lusaka, Univ. of Zambia, Rural Development Studies Bureau.

Martin, G. (1976). "Socialism, Economic Development, and Planning in Mali, 1960-1968." Canadian J. African Studies 10(1):23-46.

Mascarenhas, O., and M. Mbilinyi. (1980). Women and Development in Tanzania: An Annotated Bibliography. Addis Ababa, ECA.

Massell, B. F. (1967a). "Farm Management in Peasant Agriculture: An Empirical Study." Food Research Institute Studies 7:205-214.

_____. (1967b). "Elimination of Management Bias From Production Functions Fitted to Cross-Section Data: A Model and an Application to African Agriculture." Econometrica 35(3-4):495-508.

_____. (1969). "Consistent Estimation of Expenditure Elasticities From Cross-Section Data on Households Producing Partly for Subsistence." Rev. Econ. and Stat. 51:136-142.

Massell, B. F., and J. Heyer. (1969). "Household Expenditure in Nairobi: A Statistical Analysis of Consumer Behavior." Econ. Dev. and Cultural Change 17:212-234.

Massell, B. F., and R. W. M. Johnson. (1968). "Economics of Smallholder Farming in Rhodesia: A Cross-Section Analysis of Two Areas." Food Research Institute Studies 8: Supplement.

Massell, B. F., and A. Parnes. (1969). "Estimation of Expenditure Elasticities From A Sample of Rural Households in Uganda." Oxford Bulletin Econ. and Stat. 31:313-329.

Mathewman, R. W. (1979). A Survey of Small Livestock Production at the Village Level in the Derived Savanna and Lowland Forest Zones of S.W. Nigeria. Reading, England, Univ. of Reading, Dept. of Agr. and Hort.

Matlon, P.; T. Eponou; S. Franzel; D. Byerlee; and D. Baker. (1979). Income Distribution Among Farmers in Northern Nigeria: Empirical Results and Policy Implications. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Paper No. 18.

_____. (1980). Local Varieties, Planting Strategies and Early Season Farming Activities in Two Villages of Central Upper Volta. Ouagadougou, Upper Volta, ICRISAT, Socioeconomics Program, Village Studies Report No. 2.

Matlon, P., et al. (1979). Poor Rural Households, Technical Change, and Income Distribution in Developing Countries: Two Case Studies from West Africa. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 29.

Maxwell, S. J., and H. W. Singer. (1979). "Food Aid to Developing Countries: A Survey." World Development 7:225-247.

Maymard, J. (1974). "Structures Africaines de production et concept d'exploitation agricole. Premiere partie: un exemple de terroir Africain; les confins Diola-Manding aux bords du Sonngrongron (Senegal)." Cah. ORSTOM, Ser. Biologie 24:27-64.

Mbilinyi, M. J. (1972). "The 'New Woman' and Traditional Norms in Tanzania." J. Modern African Studies 10:57-72.

Mbithi, P. M. (1973). "Agricultural Extension as an Intervention Strategy: An Analysis of Extension Approaches" in Leonard, pp. 76-96.

_____. (1977). "Human Factors in Agricultural Management in East Africa." Food Policy 2(1):27-33.

Mbithi, P. M., and C. Barnes. (1975). The Spontaneous Settlement Problem in the Context of Rural Development in Kenya. Nairobi, East African Literature Bureau.

Mboya, T. (1967). A Development Strategy for Africa: Problems and Proposals. Nairobi, Kenya, Ministry of Economic Planning and Development.

Medani, A. I. (1975). "Elasticity of the Marketable Surplus of a Subsistence Crop at Various Stages of Development." Econ. Dev. and Cultural Change 23:421-429.

_____. (1979). "Elasticity of the Marketable Surplus of a Subsistence Crop at Various Stages of Development: Reply." Econ. Dev. and Cultural Change 28(1):179-181.

Meier, G. M. (1975). "External Trade and Internal Development" in Duignan and Gann, pp. 427-469.

Meillassoux, C. (1964). Anthropologie economique des Gouro de Cote d'Ivoire. Paris, Mouton.

_____, ed. (1971). The Development of Indigenous Trade and Markets in West Africa. London, Oxford Univ. Press for International African Institute.

_____. (1972). "From Reproduction to Production." Economy and Society. 1(1):93-105.

_____. (1974). "Development or Exploitation: Is the Sahel Famine Good Business?" Rev. Afr. Polit. Econ. 1:27-33.

_____. (1981). Maidens, Meal and Money: Capitalism and the Domestic Community. Cambridge, Cambridge Univ. Press.

Mensah, M. C. (1977). "An Experience of Group Farming in Dahomey: The Rural Development Cooperatives" in Dorner, pp. 277-286.

Menz, K. M. (1980). "Unit Farms and Farming Systems Research: The IITA Experience." Agricultural Systems 6:45-51.

Mercer-Quarshie, H. (1979). "Yields of Local Sorghum (Sorghum Vulgare) Cultivars and Their Mixtures in Northern Ghana." Tropical Agriculture 56(2):125-133.

Metson, J. (1978). "Normative Supply Response in a Mixed Farming System: A Study of Dairying and Maize Production in Nandi District, Kenya." Ph.D. dissertation, Univ. of East Anglia.

Mettrick, H. (1978). Oxenisation in the Gambia: An Evaluation. London, Ministry of Overseas Development.

Migdal, J. S. (1974). Peasants, Politics and Revolution: Pressures Toward Political and Social Change in the Third World. Princeton, Princeton Univ. Press.

Migot-Adholla, S. E. (1972). "The Politics of Mechanization in Sukumaland (Tanzania)" in Widstrand, 1971, pp. 81-104.

Mijindadi, N. B. (1980). "Production Efficiency on Farms in Northern Nigeria." Ph.D. dissertation, Cornell Univ.

Miller, L. (1977). Agricultural Credit and Finance in Africa. New York, Rockefeller Foundation.

Miller, W. (1965). "An Economic Analysis of Oil Palm Fruit Processing in Eastern Nigeria." Ph.D. dissertation, Michigan State Univ.

Minford, P., and P. Ohs. (1976). "Supply Response of Malawi Labour." Eastern Africa Econ. Rev. 8:15-34.

Miracle, M. P. (1966). Maize in Tropical Africa. Madison, Univ. of Wisconsin Press.

_____. (1968). "Market Structure in Commodity Trade and Capital Accumulation in West Africa" in Markets and Marketing in Developing Economies, R. Moyer and S. Hollander, eds. Homewood, Illinois, Irwin, pp. 209-227.

_____. (1969). "An Evaluation of Attempts to Introduce Cooperatives and Quasi-Cooperatives in Tropical Africa" in Anschel, Brannon, and Smith, 1969, pp. 120-139.

_____. (1976). "Interpretation of Backward-Sloping Labor Supply Curves in Africa." Econ. Dev. and Cultural Change 24:399-406.

Miracle, M. P., and B. Fetter. (1970). "Backward-Sloping Labor-Supply Functions and African Economic Behavior." Econ. Dev. and Cultural Change 18:246-251.

Miracle, M. P.; D. S. Miracle; and L. Cohen. (1980). "Informal Savings Mobilization in Africa." Econ. Dev. and Cultural Change 28(4):701-724.

Miracle, M. P., and A. W. Seidman. (1968a). State Farms in Ghana. Madison, Univ. of Wisconsin, Land Tenure Center, LTC Paper No. 43.

_____. (1968b). Agricultural Cooperatives and Quasi-Cooperatives in Ghana, 1951-65. Madison, Univ. of Wisconsin, Land Tenure Center, LTC Paper No. 51.

Mitchell, J. C. (1959). "The Causes of Labour Migration" in Bulletin International African Labour Institute 6(1):12-47.

Monnier, J. (1972). "Relations entre mechanisation, dimensions et systems d'exploitation." Machinisme Agricole Tropicale 38:33-44.

_____. (1975). "Farm Mechanization in Senegal and Its Effects on Production and Employment." Report of the FAO/OECD Expert Panel on the Effects of Farm Mechanization on Production and Employment. Rome, FAO, pp. 215-250.

Monnier, J.; A. Diagne; D. Sow; and T. Sow. (1974). Le travail dans l'exploitation agricole Senegalaise. Bambey, CNRA.

Monod, T., ed. (1975). Pastoralism in Tropical Africa. London, Oxford Univ. Press.

Montgomery, R. (1977). The Economics of Fertilizer Use on Sahelian Cereals: The Experience in Mali and Upper Volta. Abidjan, USAID, REDSO.

Monyo, T.; A. D. R. Ker; and M. Campbell, eds. (1976). Intercropping in Semi-Arid Areas. Ottawa, Canada, IDRC.

Moock, P. R. (1976). "The Efficiency of Women as Farm Managers: Kenya." Amer. J. Agr. Econ. 58:831-835.

_____. (1981). "Education and Technical Efficiency in Small-Farm Production." Econ. Dev. and Cultural Change 29(4):723-740.

Morawetz, D. (1974). "Employment Implications of Industrialization in Developing Countries: A Survey." Econ. J. 84:491-542.

_____. (1980). "Economic Lessons from Some Small Socialist Developing Countries." World Development 8(5/6):337-369.

Morgan, W. B. (1978). Agriculture in the Third World: A Spatial Analysis. Boulder, Colorado, Westview Press.

Moris, J. R. (1973). "Managerial Structures and Plan Implementation in Colonial and Modern Agricultural Extension: A Comparison of Cotton and Tea Programmes in Central Kenya" in Leonard, pp. 97-131.

Mortimore, M. J. (1967). "Land and Population Pressure in the Kano Close-Settled Zone, Northern Nigeria." Advancement of Science April, 23(118):677-686.

Msangi, A. S., and J. J. Griffin. (1974). International Conference on Marine Resources Development in Eastern Africa, April 4-9, 1974. Dar es Salaam, Tanzania, Univ. of Dar es Salaam; and Narragansett, Rhode Island, Univ. of Rhode Island, Marine Advisory Service.

Muchiri, G. (1979). "Development of Tillage and Equipment Systems in Kenya; With Special Reference to the Work at the University of Nairobi." Appropriate Technology for Tillage Operations Workshop. Zaria, Nigeria, Ahmadu Bello Univ., IAR.

Mudahar, M. S. (1980). "Principal Policy Issues Facing the Fertilizer Sector in Africa: A Perspective." Muscle Shoals, Alabama, International Fertilizer Development Center. (DRAFT).

Mukui, J. T., ed. (1979). Price and Marketing Controls in Kenya. Nairobi, Univ. of Nairobi, IDS, Occasional Paper No. 32.

Murray, C. (1977). "High Bridewealth, Migrant Labour and the Position of Women in Lesotho." J. African Law 21(1):79-96.

Mwangi, W. M. (1978). "Farm Level Derived Demand Responses for Fertilizer in Kenya." Ph.D. dissertation, Michigan State Univ.

Mwansasu, B. U., and C. Pratt, eds. (1979). Towards Socialism in Tanzania. Toronto, Univ. of Toronto Press.

Mwanza, J. M. (1979). "Rural-Urban Migration and Urban Employment in Zambia" in Turok, pp. 26-36.

Myint, H. (1958). "The 'Classical Theory' of International Trade and the Underdeveloped Countries." Econ. J. 68:317-337.

National Research Council. (1968). Conference on Agricultural Research Priorities for Economic Development in Africa. 3 vols. Washington, National Academy of Sciences.

National Research Council, Committee on African Agricultural Capabilities. (1974). African Agricultural Research Capabilities. Washington, National Academy of Sciences.

_____. (1978). Post-Harvest Food Losses in Developing Countries. Washington, National Academy of Sciences.

Ndegwa, P. (1968). The Common Market and Development in East Africa. Nairobi, East African Publishing House.

Nelson, M. (1973). The Development of Tropical Lands: Policy Issues in Latin America. Baltimore, Johns Hopkins Univ. Press.

Netting, R. (1968). Hill Farmers of Nigeria: Cultural Ecology of the Kofyar of the Jos Plateau. Seattle, Univ. of Washington Press.

_____. (1974). "Agrarian Ecology." Annual Review of Anthropology 3:21-57.

Newbury, C. W., and A. S. Kanya-Forstner. (1969). "French Policy and the Origins of the Scramble for West Africa." J. African History 10(2):253-276.

Newman, M.; I. Ouedraogo; and D. Norman. (1980). "Farm Level Studies in the Semi-Arid Tropics of West Africa" in ICRISAT, 1980a, pp. 241-263.

Ng' ethe, N. (1980). "Income Distribution in Kenya: The Politics of Mystification" in J. F. Rweyemamu, ed., pp. 191-213.

Ngoddy, P. O. (1976). "Gari Mechanization in Nigeria: The Competition Between Intermediate and Modern Technology" in Appropriate Technology: Problems and Promises, N. Jequier, ed. Paris, OECD, pp. 260-275.

Niang, A. (1980). "L.P. Modelling of African Farms, the Sahel Farm Model: Case Studies: Mali and Senegal" in Purdue Univ., 1980.

Nicou, R. (1978). "Etude de succession culturales au Senegal. Resultats et methodes." L'Agronomie Tropicale 33(1):51-61.

Nigeria, Federal Ministry of Agriculture. (1980a). The Green Revolution: A Food Production Plan for Nigeria. (Final Report). Vol. I. Lagos, Federal Ministry of Agriculture.

_____. (1980b). The Green Revolution: A Food Production Plan for Nigeria. (Final Report). Vol. 2. Annexes. Lagos, Federal Ministry of Agriculture.

Nigeria, Federal Ministry of Agriculture and Rural Development, Western Region. (1959). Future Policy of the Ministry of Agriculture and Natural Resources. Sessional Paper No. 9.

Nkrumah, K. (1963). Africa Must Unite. New York, Praeger.

_____. (1970). Class Struggle in Africa. New York, International Publishers.

Norman, D. W. (1969). "Labour Inputs of Farmers: A Case Study of the Zaria Province of the North Central State of Nigeria." Nigerian J. Econ. Soc. Studies 11:3-14.

_____. (1972). An Economic Study of Three Villages in Zaria Province. 2. An Input-Output Study. Vol. I, Text. Zaria, Nigeria, Ahmadu Bello Univ., IAR, Samaru Miscellaneous Paper No. 37.

_____. (1973). Methodology and Problems of Farm Management Investigations: Experiences From Northern Nigeria. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Employment Paper No. 8.

_____. (1974). "Rationalizing Mixed Cropping Under Indigenous Conditions: The Example of Northern Nigeria." J. Development Studies 11:3-21.

_____. (1980). The Farming System's Approach: Relevancy for the Small Farmer. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Paper No. 5. (Also in French and Spanish.)

Norman, D. W.; P. Beeden; W. J. Kroeker; D. H. Pryor; H. M. Hays; and B. Huizinga. (1976a). The Feasibility of Improved Sole Crop Maize Production Technology for the Small-Scale Farmer in the Northern Guinea Savanna Zone of Nigeria. Zaria, Ahmadu Bello Univ., IAR, Samaru Miscellaneous Paper No. 59.

Norman, D. W.; P. Beeden; W. J. Kroeker; D. H. Pryor; B. Huizinga; and H. M. Hays. (1976b). The Feasibility of Improved Sole Crop Sorghum Production Technology for the Small-Scale Farmer in the Northern Guinea Savanna Zone of Nigeria. Zaria, Ahmadu Bello Univ., IAR, Samaru Miscellaneous Paper No. 60.

Norman, D. W.; J. C. Fine; A. D. Goddard; W. J. Kroeker; and D. H. Pryor. (1976). A Socio-Economic Survey of Three Villages in the Sokoto Close-Settled Zone. 3. Input-Output Study. Vol. I. Text. Zaria, Ahmadu Bello Univ., IAR, Samaru Miscellaneous Paper No. 64.

Norman, D. W.; J. A. Hayward; and H. R. Hallam. (1974). "An Assessment of the Cotton Growing Recommendations As Applied by Nigerian Farmers." Cotton Growing Rev. 51:266-288.

_____. (1975). "Factors Affecting Cotton Yields Obtained by Nigerian Farmers." Cotton Growing Rev. 52(1):30-37.

Norman, D. W.; M. D. Newman; and I. Ouedraogo. (1981). Farm and Village Production Systems in the Semi-Arid Tropics of West Africa. Hyderabad, India, ICRISAT, Research Bulletin No. 4, Vol. I.

Norman, D. W., and R. W. Palmer-Jones. (1977). "Economic Methodology for Assessing Cropping Systems" in Symposium on Cropping Systems Research and Development for the Asian Rice Farmer. Los Banos, Philippines, IRRI.

Norman, D. W.; D. H. Pryor; and C. J. N. Gibbs. (1979). Technical Change and the Small Farmer in Hausaland, Northern Nigeria. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Paper No. 21.

Ntangsi, J. V. (1979). "The Political Economy of Rural Development in Cameroon." Ph.D. dissertation, Univ. of California, Berkeley.

Nukunya, G. K. (1975). "The Effects of Cash Crops on an Ewe Community" in Goody, pp. 59-71.

Nweke, F. I. (1978a). "Agricultural Credit in Ghana: Priorities and Needs for Domestic Food Production." Canadian J. Agr. Econ. 26(3):38-46.

_____. (1978b). "Direct Governmental Production in Agriculture in Ghana, Consequences for Food Production and Consumption, 1960-66 and 1967-75." Food Policy 3(3):202-208.

_____. (1979). "Farm Mechanization and Farm Labour in Ghana: An Analysis of Efficiency and Impact on Domestic Food Production and Policy Issues." Zeitschrift Fur Auslandische Landwirtschaft 18(2):171-187.

Nyantenz, V. K. (1972). The Storage of Foodstuffs in Ghana. Legon, Ghana, Univ. of Ghana, ISSER, Technical Publication Series No. 18.

Nye, P. H., and D. H. Greenland. (1960). The Soil Under Shifting Cultivation. Farnham Royal, Commonwealth Agricultural Bureau.

Nyerere, J. K. (1967). Socialiam and Rural Development. Dar es Salaam, Government Printer. (Also in Nyerere, 1968, pp. 106-144.)

_____. (1968). Ujamaa: Essays on Socialism. Oxford, Oxford Univ. Press.

_____. (1977). The Arusha Declaration: Ten Years After. Dar es Salaam, Government Printer. (Reprinted in abridged form in International Development Rev. 19(1):2-7.)

OAU. (1980). The Lagos Plan of Action for the Implementation of the Monrovia Strategy for the Economic Development of Africa. Lagos, Nigeria, OAU.

Obeng, H. B. (1978). "Major Soils of West Africa and Their General Suitability for Crop and Livestock Production." African J. Agr. Sciences 5(1):71-83.

Odell, M. L., and M. J. Odell, Jr. (1980). The Evolution of a Strategy for Livestock Development in the Communal Areas of Botswana. London, ODI, Pastoral Network Paper No. 10b.

Odero-Ogwel, L., and E. Clayton. (1973). A Regional Programming Approach to Agricultural Sector Analysis: An Application to Kenya Agriculture. Ashford, Kent, Wye College, Agrarian Development Studies Report No. 5.

Oduor-Otieno, M. L.; R. S. Karisa; J. O. O. Othiambo; and T. C. I. Ryan. (1978). A Study of the Supply Function for Fish in the Kenya Waters of Lake Victoria and on the Kenya Coast. Nairobi, Univ. of Nairobi, IDS, Working Paper No. 346.

Ofori, I. M., ed. (1973). Factors of Agricultural Growth in West Africa. Proceedings of an International Conference held at Legon, April 1971. Legon, Univ. of Ghana, ISSER.

Ogunfowora, O. (1972). "Conceptualizing Increased Resource Demand and Product Supply Inducing Policies in Peasant Agriculture." Nigerian J. Econ. Soc. Studies 14:191-201.

Ogunfowora, O., and D. W. Norman. (1973). "Farm-Firm Normative Fertilizer Demand Response in the North Central State of Nigeria." J. Agr. Econ. 24(2):301-309.

_____. (1974). An Optimization Model for Evaluating the Stability of Sole Cropping and Mixed Cropping Systems Under Changing Resource and Technology Levels. Zaria, Nigeria, Ahmadu Bello Univ., IAR, Research Bulletin No. 217.

Okai, M. (1975). "The Development of Ox Cultivation Practices in Uganda." East African J. Rural Development 8(1-2):191-214.

Okali, C., and R. A. Kotey. (1971). Akokoaso: A Resurvey. Legon, Ghana, Univ. of Ghana, ISSER.

Okedi, J. (1974). Fishery Resources: Their Exploitation, Management and Conservation in Africa. Jinja, Uganda, Eastern Africa Freshwater Fisheries Research Organization.

Okediji, F. O. (1972). "Family Planning in Africa: Overcoming Social and Cultural Resistance." Revue Internationale de l'Education de la Sante (Geneve) 15:199-206.

Okidi, C. O., ed. (1978). Management of Coastal and Offshore Resources in Eastern Africa. Paper presented at the Workshop. Nairobi, Univ. of Nairobi, IDS, Occasional Paper No. 28.

_____. (1979). Kenya's Marine Fisheries: An Outline of Policy and Activities. Nairobi, Univ. of Nairobi, IDS, Occasional Paper No. 30.

Okigbo, B. N., and D. J. Greenland. (1977). "Intercropping Systems in Tropical Africa" in Multiple Cropping, R. I. Papendick, P. A. Sanchez, and G. B. Triplett, eds. Madison, Wisconsin, American Society of Agronomy, pp. 63-101.

Okurume, G. (1973). Foreign Trade and the Subsistence Sector in Nigeria: The Impact of Agricultural Exports on Domestic Food Supplies in a Peasant Economy. New York, Praeger.

Olayemi, J. K. (1974). "Costs and Returns to Cocoa and Alternative Crops in Western Nigeria" in Kotey, Okali, and Rourke, pp. 48-58.

_____. (1976). "Irreversible Price Response Patterns: The Case of Nigerian Rubber Producers." J. Rural Econ. and Development 10(2):28-35.

Olayemi, J. K., and S. A. Oni. (1972). "Asymmetry in Price Response: A Case Study of Western Nigerian Cocoa Farms." Nigerian J. Econ. Soc. Studies 14:347-356.

Olayide, S. O. (1972). "Some Estimates of Supply Elasticities for Nigeria's Cash Crops." J. Agr. Econ. 23:263-276.

_____. (1974). "Some Estimates of Supply Elasticities for Nigeria's Cash Crops: A Rejoinder." J. Agr. Econ. 25(2):181-190.

Olayide, S. O.; J. A. Eweka; and V. E. Bello-Osagie, eds. (1980). Nigerian Small Farmers: Problems and Prospects in Integrated Rural Development. Ibadan, Univ. of Ibadan, Center for Agricultural and Rural Development.

Olayide, S. O., and T. J. O. Ogunfiditimi. (1980). "Agricultural Extension and Nigerian Small Farmers" in Olayide, Eweka, and Bello-Osagie, pp. 257-271.

Olayide, S. O.; O. Ogunfowora; and S. M. Essang. (1974). "Effects of Marketing Board Pricing Policies on the Nigerian Economy: A Systems Simulation Experiment." J. Agr. Econ. 25:289-309.

Olayide, S. O.; and J. K. Olayemi. (1978). "Economic Aspects of Agriculture and Nutrition: A Nigerian Case Study." Food and Nutrition Bulletin 1(1):32-39.

Oloya, J. J. (1969). Coffee, Cotton, Sisal, and Tea in the East African Economies. Nairobi, East African Literature Bureau.

Oluwasanmi, H. A. (1975). "Effects of Farm Mechanization on Production and Employment in Nigeria." Report of the FAO/OECD Expert Panel on the Effects of Farm Mechanization on Production and Employment. Rome, FAO, pp. 51-70.

Oluwasanmi, H. A.; D. M. Lang; W. M. Corbett; J. S. Oguntoyinbo; C. Okali; I. S. Dema; N. O. Osamo; R. O. Adegboye; M. Upton; and W. H. O. Ezeilo. (1966). Uboma: A Socio-Economic and Nutritional Survey of a Rural Community in Eastern Nigeria. Bude, Cornwall, England, Geographical Publications Limited, The World Land Use Survey, Occasional Paper No. 6.

Omari, C. K., ed. (1976). The Strategy for Rural Development: Tanzanian Experience. Nairobi, East African Literature Bureau.

Ongla, J. (1978). "Structure, Conduct and Performance of the Food Crop Marketing System in Cameroon: A Case Study of Yaounde and Adjacent Areas." Ph.D. dissertation, Univ. of Florida.

Oni, S. A. (1969a). "Econometric Analysis of Supply Response Among Nigerian Cotton Growers." Bulletin Rural Econ. and Sociology 4:203-225.

_____. (1969b). "Production Response in Nigerian Agriculture: A Case Study of Palm Produce, 1949-1966." Nigerian J. Econ. Soc. Studies 11:81-92.

Oni, S. A., and J. K. Olayemi. (1975). "The Economics of Rice Milling in Kwara and North-Western States of Nigeria: A Comparative Analysis" in Are, 1975.

Onitiri, H. M. A., and D. Olatunbosun, eds. (1974). The Marketing Board System. Proceedings of an International Conference. Ibadan, Ibadan Univ. Press.

Onwueme, I. C. (1978). The Tropical Tuber Crops: Yams, Cassava, Sweet Potato, and Cocoyams. New York, John Wiley and Sons.

Ord, H. W.; F. M. Andic; R. M. Bostock; and Y. Yannoulis. (1964). Ghana: Projected Level of Demand, Supply and Imports of Agricultural Products in 1965, 1970 and 1975. Washington, USDA, ERS.

ORSTOM. (1975). Les migrations de travail Mossi. 11 Vols. Ouagadougou.

_____. (1979). Maitrise de la l'espace agraire et developpement en Afrique tropicale: logique paysanne et rationalite technique. Actes du colloque de Ouagadougou, 4-8 Decembre 1978. Paris, Memoires ORSTOM No. 89.

Ostby, I., and T. Gulilat. (1969). "A Statistical Study of Household Expenditure in Addis Ababa." Eastern Africa Econ. Rev. 1:63-74.

Osuntogun, A. (1978). "The Impact of Co-operative Credit on Farm Income and the Efficiency of Resource Use in Peasant Agriculture: A Case Study from Three States of Nigeria." African J. Agr. Sci. 5(2):1-6.

_____. (1980). "Farm Level Credit Among Co-Operative Farmers in Nigeria" in J. Howell, pp. 259-272.

Otieno, J.; G. Muchiri; and B. F. Johnston. (1975). "Expanded Use and Local Manufacture of Appropriate Farm Equipment in Kenya's Strategy for Rural Development" in Westley and Johnston, 1975.

Ouedraogo, I.; M. D. Newman; and D. W. Norman. (1982). The Farmer in the Semi-Arid Tropics of West Africa: Partially Annotated Bibliography. Patancheru, India, ICRISAT.

Owosekun, A. (1976). "Agricultural Supply Response. II. A Case Study of the Supply of Groundnuts to the Marketing Board of the Northern States of Nigeria." East African J. Rural Development 9(1/2):130-139.

Oxaal, I.; T. Barnett; and D. Booth. (1975). Beyond the Sociology of Development: Economy and Society in Latin America and Africa. London and Boston, Routledge and Kegan Paul.

Oyenuga, V. A. (1973). "Intensive Animal Production on a Subsistence Scale" in Proceedings of Third World Conference on Animal Production, R. L. Reid, ed. Melbourne, pp. 393-400.

Page, J. M., Jr. (1979). Small Enterprises in African Development: A Survey. Washington, World Bank, Staff Working Paper No. 363.

Pala, A. (1976). African Women in Rural Development: Research Trends and Priorities. Washington, ACE, Overseas Liaison Committee.

Palma, G. (1978). "Dependency: A Formal Theory of Underdevelopment or a Methodology for the Analysis of Concrete Situations of Underdevelopment?" World Development 6(7/8):881-924.

Palmer, R., and N. Parsons, eds. (1977). The Roots of Rural Poverty in Central and Southern Africa. London, Heinemann.

Palmer-Jones, R. W. (1974). Production and Marketing of Tea in Malawi. Reading, Univ. of Reading, Dept. of Agr. Econ. and Mgt.

_____. (1977a). "A Comment on Planned Versus Actual Farmer Performance Under Uncertainty in Underdeveloped Agriculture." J. Agr. Econ. 28(2):177-179.

_____. (1977b). "Irrigation System Operating Policies for Mature Tea in Malawi." Water Resources Research 13(1):1-7.

_____. (1979). "Linear Programming and the Study of Peasant Farming: A Rejoinder." J. Agr. Econ. 30(2):199-204.

_____. (1981). "How Not to Learn From Pilot Irrigation Projects: The Nigerian Experience." Water Supply and Management (Oxford) 5(1):81-105.

Parkin, D. J. (1972). Palms, Wine and Witnesses: Public Spirit and Private Gain in an African Farming Community. San Francisco, Chandler Publishing Co.

_____, ed. (1975). Town and Country in Central and Eastern Africa. London, Oxford Univ. Press for International African Institute.

Parsons, K. H. (1971). Customary Land Tenure and Development of African Agriculture. Madison, Univ. of Wisconsin, Land Tenure Center, Research Paper No. 77.

Paylore, P., ed. (1976). Desertification: A World Bibliography. Tucson, Univ. of Arizona, Office of Arid Land Studies.

Paylore, P., and J. A. Mabbutt. (1980). Desertification: World Bibliography Update, 1976-80. Tucson, Univ. of Arizona, Office of Arid Land Studies.

Pearse, A. (1980). Seeds of Plenty: Seeds of Want: Social and Economic Implications of the Green Revolution. New York, Oxford Univ. Press.

Pearson, S. R., and J. Cownie. (1974). Commodity Exports and African Economic Development. Lexington, Mass., Heath.

Pearson, S. R., and W. D. Ingram. (1980). "Economies of Scale, Domestic Divergences, and Potential Gains From Economic Integration in Ghana and the Ivory Coast." J. Polit. Econ. 88(5):994-1008.

Pearson, S. R., and R. K. Meyer. (1974). "Comparative Advantage Among African Coffee Producers." Amer. J. Agr. Econ. 56:310-313.

Pearson, S. R.; J. D. Stryker; C. P. Humphreys; et al. (1981). Rice in West Africa: Policy and Economics. Stanford, Calif., Stanford Univ. Press.

Peek, P., and G. Standing. (1979). "Rural-Urban Migration and Government Policies in Low Income Countries." International Labor Rev. 118(6):747-762.

Pelissier, P. (1966). Les paysans du Senegal. Les civilisations agraires du Cayor a la Casamance. St.-Yrieix, Imprimerie Fabregue.

Perisse, J. (1962). "L'alimentation des populations rurales du Togo." Annales de la Nutrition et d'Alimentation 16(6):1-58.

Perrault, P. T. (1978). "Banana-Manioc Farming Systems of the Tropical Forest: A Case Study of Zaire." Ph.D. dissertation, Stanford Univ.

Perrin, R. K.; D. L. Winkelman; E. R. Moscardi; and J. R. Anderson. (1976). From Agronomic Data to Farmer Recommendations: An Economics Training Manual. Mexico, CIMMYT.

Phillips, A. O. (1975). Review of Income Distribution Data: Ghana, Kenya, Tanzania and Nigeria. Princeton, Princeton Univ., Woodrow Wilson School, Discussion Paper No. 58.

Phillips, J. (1959). Agriculture and Ecology in Africa. A Study of Actual and Potential Development South of the Sahara. London, Faber and Faber.

Picard, L. A. (1979). "Rural Development in Botswana: Administrative Structures and Public Policy." J. Development Areas 13(3):283-300.

Pieri, C.; F. Ganry; and P. Siband. (1978). "Proposition pour une interpretation agro-economique des essais d'engrais. Exemples des fumures azotee et potassique du mil au Senegal." L'Agronomie Tropicale 33(1):32-39.

Pinstrup-Andersen, P. (1981). Nutritional Consequences of Agricultural Projects: Conceptual Relationships and Assessment Approaches. Washington, World Bank, Staff Working Paper No. 456.

Plange, Nii-K. (1979). " 'Opportunity Cost' and Labour Migration: A Misinterpretation of Proletarianisation in Northern Ghana." J. Modern African Studies 17(4):655-676.

Plattner, S., ed. (1975). Formal Methods in Economic Anthropology. Washington, American Anthropological Association.

Polanyi, K.; C. M. Arensberg; and H. W. Pearson. (1957). Trade and Market in Early Empires. New York, Free Press.

Poleman, T. T. (1961). "The Food Economies of Urban Middle Africa: The Case of Ghana." Food Research Institute Studies 2:121-174.

Popkin, S. L. (1979). The Rational Peasant: The Political Economy of Rural Society in Vietnam. Berkeley, Univ. of California Press.

Posner, R. A. (1980). "Anthropology and Economics." J. Polit. Econ. 88(3):608-616.

Post, K. (1972). "Peasantization and Rural Political Movements in Western Africa." Archives Europeennes de Sociologie 13:223-254.

Poulain, J.-F.; M. Sedogo; F. Ouali; and P. Morant. (1979). "La Demarche systeme en agronomie: essais de definition des zones homogenes en Haute-Volta et propositions de systemes de cultures vulagrisalles" in ORSTOM, 1979.

Prakah-Asante, K. (1976). "The Economics of Size of Food Crop Farms in the Mampong-Enura Agricultural District of Ghana." Ph.D. dissertation, Washington State Univ.

Pratt, D. J., and M. D. Gwynne, eds. (1977). Rangeland Management and Ecology in East Africa. London, Hodder and Stoughton.

Prebisch, R. (1959). "Commercial Policy in Underdeveloped Countries." Amer. Econ. Rev. 49(2):251-273.

Priovolos, T. (1981). Coffee and The Ivory Coast: An Econometric Study. Lexington, Mass., Lexington Books.

Pryor, R. A. (1977). The Origins of the Economy: A Comparative Study of Distribution in Primitive and Peasant Economies. New York, Academic Press.

Pudsey, D. (1967). An Economic Survey of Farming in a Wet, Long Grass Area of Toro. Entebbe, Uganda, Department of Agriculture.

Pullan, N. B., and R. J. Grindle. (1980). "Productivity of White Fulani Cattle on the Jos Plateau, Nigeria, IV. Economic Factors." Tropical Animal Health Proceedings 12:161-170.

Purdue University. (1980). Workshop on Sahelian Agriculture, May 1980. Lafayette, Ind., Purdue Univ., Dept. of Agr. Econ.

Purvis, M. J. (1968a). "The Nigerian Oil Palm Industry: A Comment." Food Research Institute Studies 8(2):191-197.

_____. (1968b). A Study of the Economics of Tractor Use in Oyo Division of the Western State. East Lansing, Michigan State Univ., Consortium for the Study of Nigerian Rural Development, Report No. 17.

_____. (1970). "New Sources of Growth in a Stagnant Smallholder Economy in Nigeria: The Oil Palm Rehabilitation Scheme" in Eicher and Liedholm, pp. 267-281.

Putt, S., et al. (1980). The Social and Economic Implications of Trypanosomiasis Control: A Study of Its Impact on Livestock Production and Rural Development in Northern Nigeria. Reading, England, Univ. of Reading.

Quick, S. A. (1977). "Bureaucracy and Rural Socialism in Zambia." J. Modern African Studies 15(3):379-400.

_____. (1978). Humanism or Technocracy: Zambia's Farming Cooperatives, 1965-72. Lusaka, Zambia, Univ. of Zambia, Institute for African Studies.

Quinn, N. (1978). "Do Mfantse (Ghana) Fish Sellers Estimate Probabilities in Their Heads." Amer. Ethnologist 5:206-226.

Rachie, K. O., and P. Silvestre. (1977). "Grain Legumes" in Leakey and Wills, 1977, pp. 41-74.

Raikes, P. (1978). "Rural Differentiation and Class Formation in Tanzania." J. Peasant Studies 5(3):285-325.

Ramond, C. (1971). L'introduction des themes intensifs dans les exploitation traditionneles: consequences economiques. Bambey, Senegal, CNRA.

Ranger, T. (1978). "Growing From the Roots: Reflections on Peasant Research in Central and Southern Africa." J. Southern African Studies 5(1):99-133.

Raynaut, C. (1973). Structures normatives et relations electives: etude d'une communaute villageoise haoussa. Paris, Mouton.

_____. (1977). "Circulation monetaire et evolution des structures socio-economiques chez les Haoussas du Niger." Africa 47:160-171.

_____. (1980). "The Contribution of the Anthropologist in the Study of Agricultural Production Systems (The Case of Maradi in Niger)" in Purdue, 1980.

Rempel, H. (1971). "Labour Migration Into Urban Areas and Urban Employment in Kenya." Ph.D. dissertation, Univ. of Wisconsin.

Rempel, H., and W. J. House. (1978). The Kenya Employment Problem: An Analysis of the Modern Sector Labour Market. Nairobi, Oxford Univ. Press.

Rempel, H., and R. Lobdell. (1978). "The Role of Urban-to-Rural Remittances in Rural Development." J. Development Studies 14(3):324-341.

Remy, G. (1977). Enquete sur les mouvements de population a partir du pays mossi. Paris, ORSTOM.

Resnick, S. A. (1970). "The Decline of Rural Industry Under Export Expansion: A Comparison Among Burma, Philippines, and Thailand, 1870-1938." J. Econ. History 30:51-73.

Reusse, E. (1976). "Economic and Marketing Aspects of Post-Harvest Systems in Small Farmer Economies." Monthly Bulletin Agr. Econ. and Stat. 25(10):1-10.

Reutlinger, S. (1966). "Short Run Beef Supply Response." Amer. J. Agr. Econ. 48:909-919.

Reutlinger, S., and M. Selowsky. (1976). Malnutrition and Poverty: Magnitude and Policy Options. Baltimore, Johns Hopkins Univ. Press.

Reyna, S. (1977). "Marriage Payments, Household Structure, and Domestic Labour Supply Among the Barma of Chad." Africa 47:81-88.

Richard, J. F.; M. Fall; and J. M. Attonaty. (1976). Le model "4S" programme lineare pour les exploitations agricoles du sine saloum-sud au Senegal et calculs de budgets automatises. Bambey, Senegal, IRAT/ISRA.

Richards, A. (1932). Hunger and Work in a Savage Tribe. London, Routledge.

_____. (1939). Land, Labour and Diet in Northern Rhodesia. London, Oxford Univ. Press.

Richards, A. I.; F. Sturrock; and J. M. Fortt, eds. (1973). Subsistence to Commercial Farming in Present Day Buganda: An Economic and Anthropological Survey. Cambridge, Cambridge Univ. Press.

Riddell, J. B. (1974). "Periodic Markets in Sierra Leone." Association of American Geographers, Annals 64(4):541-548.

_____. (1978). "The Migration to the Cities of West Africa: Some Policy Considerations." J. Modern African Studies 16(2):241-260.

Riddell, J. C.; K. H. Parsons; and D. Kanel. (1978). "Land Tenure Issues in African Development: A Position Paper." Madison, Univ. of Wisconsin, Dept. of Agr. Econ. (DRAFT).

Riesman, P. (1977). Freedom in Fulani Social Life: An Introspective Ethnology. Translation by M. Fuller. Chicago, Univ. of Chicago Press.

_____. (1978). The Fulani in a Development Context: The Relevance of Cultural Tradition for Coping with Change and Crisis. Abidjan, USAID.

Riley, P., and M. T. Weber. (1979). Food and Agricultural Marketing in Developing Countries: An Annotated Bibliography of Doctoral Research in the Social Sciences, 1969-79." East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Working Paper No. 5.

Rimmer, D. C. (1969). "The Abstraction From Politics: A Critique of Economic Theory and Design with Reference to West Africa." J. Development Studies 5:190-204.

Roberts, R. A. J. (1972). "The Role of Money in the Development of Farming in the Mumbawa and Katete Areas of Zambia." Ph.D. dissertation, Univ. of Nottingham.

Robertson, C. (1974). "Economic Women in Africa: Profit-Making Techniques of Accra Market Women." J. Modern African Studies 12:657-664.

Robinson, K. L. (1974). "The Economics of Increasing Staple Food Production in West Africa." Ibadan, Nigeria, IITA. (Unpublished paper).

Robinson, K. L., and A. O. Falusi. (1974). The Present and Potential Role of Fertilizer in Meeting Nigeria's Food Requirements. Ithaca, Cornell Univ., International Agricultural Monograph No. 46. (Also appears in Nigerian Agr. J., 1974, 2(3):100-107.)

Robson, P. (1968). Economic Integration in Africa. London, Allen and Unwin, Ltd.

Rocheteau, G. (1975). "Pionniers mourides au Senegal: colonisation des terres neuves et transformations d'une economie paysanne." Cahiers ORSTOM, Ser. Sci. Hum. 12(1):19-53.

Rodney, W. (1974). How Europe Underdeveloped Africa. Washington, Howard Univ. Press.

Rogers, E. M. (1976a). "Communication and Development: The Passing of the Dominant Paradigm." Communication Research 3(2):213-240.

_____. (1976b). "Where We Are in Understanding the Diffusion of Innovations?" in Communication and Change in the Developing Countries: Ten Years After, W. Schramm and D. Lerner, eds. Honolulu, Univ. of Hawaii, East-West Center Press, pp. 204-222.

Roider, W. (1971). Farm Settlements for Socio-Economic Development - The Western Nigeria Case. Munich, West Germany, Weltforum Verlag.

Roling, N. G. (1970). "Adaptations in Development: A Conceptual Guide to the Study of Non-Innovative Response of Peasant Farmers." Econ. Dev. and Cultural Change 19(1):71-85.

Roling, N. G.; J. Ascroft; and F. Chege. (1976). "The Diffusion of Innovations and the Issue of Equity in Rural Development." Communication Research 3:155-170.

Roose, E. J. (1977). "Adaptation des methodes de conservation des sols aux conditions ecologiques et socio-economique de l'Afrique de l'Ouest." L'Agronomie Tropicale 32(2):132-140.

Rosberg, C. G., and T. G. Callaghy, eds. (1979). Socialism in Sub-Saharan Africa: A New Assessment. Berkeley, Univ. of California Press, Institute of International Studies.

Rosenboom, H. P., and R. E. Parker. (1975). "Economics of Small-Scale Rice Mills" in Are, 1975.

Ross, C. G. (1980). "Grain Demand and Consumer Preference in Senegal." Food Policy 5(4):273-281.

Rothschild, B. J., ed. (1972). World Fisheries Policy: Multidisciplinary Views. Seattle and London, Univ. of Washington Press.

Roy, D. K., and S. J. Mabey. (1968). Household Budget Survey in Ghana. Legon, Ghana, Univ. of Ghana, Institute of Statistics.

Ruigu, G. M. (1978). "An Economic Analysis of the Kenya Milk Subsystem." Ph.D. dissertation, Michigan State Univ.

Rukandema, F. M. (1978). "Resource Availability, Utilization and Productivity on Small-Scale Farms in Kakamega District, Western Kenya." Ph.D. dissertation, Cornell Univ.

Ruthenberg, H. (1968). Smallholder Farming and Smallholder Development in Tanzania: Ten Case Studies. Munich, West Germany, Weltforum Verlag.

_____. (1974). "Artificial Pastures and Their Utilization in the Southern Guinea Savanna and the Derived Savanna of West Africa. Tour d'Horizon of an Agricultural Economist." (Two Parts). Zeitschrift fur Auslandische Landwirtschaft 13(3):216-231 and (4):312-330.

_____. (1980). Farming Systems in the Tropics. 3rd edition. London, Oxford Univ. Press.

Ruttan, V. (1975). "Integrated Rural Development Programs: A Skeptical Perspective." International Development Review 17(4):9-16.

Rweyemamu, J. F., ed. (1980). Industrialization and Income Distribution in Africa. Dakar, Senegal, CODESRIA.

Sabot, R. H. (1979). Economic Development and Urban Migration, Tanzania, 1900-1971. Oxford, Clarendon Press.

_____, ed. (1981). Migration and the Labor Market in Developing Countries. Boulder, Col., Westview Press.

Sahel Bibliographic Bulletin. Vols. 1-5 (1977-1981). East Lansing, Michigan State Univ., Library.

Sahlins, M. (1974). Stone Age Economics. Chicago, Aldine.

Saila, S. B., and P. M. Roedel, eds. (1979). Stock Assessment for Tropical Small-Scale Fisheries: Proceedings of an International Workshop Held September 19-21, 1979. Kingston, R.I., Univ. of Rhode Island, International Center for Marine Resource Development.

Salzman, P. C., ed. (1980). When Nomads Settle: Processes of Sedentarization as Adaptation and Response. New York, Praeger.

Samoff, J. (1981). "Crises and Socialism in Tanzania." J. Modern African Studies 19(2):279-306.

Sands, M., and R. E. McDowell. (1979). A World Bibliography on Goats. Ithaca, N.Y., Cornell Univ., International Agriculture Mimeograph No. 70.

Sanford, S. (1977). Dealing With Drought and Livestock in Botswana. London, Overseas Development Institute.

Sargent, M.; J. Lichte; P. Matlon; and R. Bloom. (1981). An Assessment of Animal Traction in Francophone West Africa. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 34.

Saul, J. S. (1977). "Tanzania's Transition to Socialism?" Canadian J. African Studies 11:313-339.

_____. (1979). The State and Revolution in Eastern Africa. New York, Monthly Review Press.

Saul, M. (1980). "Beer, Sorghum and Women: Production for the Market in Rural Upper Volta" in Purdue University, 1980.

Saunders, M. O. (1980). "Hausa Irrigated Agriculture at Merria, Niger" in Purdue, 1980.

Savane, M. A. (1981). Implications for Women and Their Work of Introducing Nutritional Considerations Into Agricultural and Rural Development Projects. Rome, 7th Session of the ACC Sub-Committee on Nutrition, United Nations.

Savonnet, G. (1962). "La colonisation du pays Koulango (Haute-Cote-d'Ivoire) par les Lobi de Haute-Volta." Cah. d'Outre-Mer 57:25-46.

_____. (1976). "Inegalites de developpement et organisation sociale (exemple empruntes au sud-ouest de la Haute-Volta)." Cah. ORSTOM, Ser. Sci. Hum. 13(1):23-40.

Sawadogo, A. (1977). L'Agriculture en Cote d'Ivoire. Paris, Presses Universitaires de France.

Saylor, R. G. (1967). The Economic System of Sierra Leone. Durham, N.C., Duke Univ. Press.

_____. (1974). "Farm Level Cotton Yields and the Research and Extension Services in Tanzania." Eastern Africa J. Rural Development 7:46-60.

Saylor, R. G., and C. K. Eicher. (1970). "Plantations in Nigeria: Lessons for West African Development" in Bunting, 1970, pp. 497-530.

Schadler, K. (1968). Crafts, Small-Scale Industries, and Industrial Education in Tanzania. Munich, West Germany, Weltforum Verlag.

Schapera, I. (1947). Migrant Labour and Tribal Life: A Study of Conditions in the Bechuanaland Protectorate. London, Oxford Univ. Press.

Schiffer, J. (1981). "The Changing Post-War Pattern of Development: The Accumulated Wisdom of Samir Amin." World Development 9(6):515-537.

Schneider, H. K. (1974). Economic Man: The Anthropology of Economics. New York, Free Press.

_____. (1975). "Economic Development and Anthropology" in Siegel, Beals, and Tyler, 1975, pp. 271-292.

_____. (1979). Livestock and Equality in East Africa: The Economic Basis for Social Structure. Bloomington, Indiana Univ. Press.

Schulman, R. (1979). "Strategy for the Advancement of Animal Traction in Mali." Bamako, Mali, USAID. (Mimeograph).

Schultz, T. W. (1964). Transforming Traditional Agriculture. New Haven, Yale Univ. Press.

_____, ed. (1978). Distortions of Agricultural Incentives. Bloomington, Ind., Indiana Univ. Press.

_____. (1980). "Nobel Lecture: The Economics of Being Poor." J. Polit. Econ. 88(4):639-651.

Schulz, M. (1976). Organizing Extension Services in Ethiopia Before and After the Revolution. Saarbrucken, Verlag der SSIP-Schriften Breitenbach.

Schwimmer, B. E. (1980). "The Organization of Migrant Farmer Communities in Southern Ghana." Canadian J. African Studies 14(2):221-238.

Scott, E. P. (1972). "The Spatial Structure of Rural Northern Nigeria: Farmers, Periodic Markets and Villages." Econ. Geography 48:316-332.

_____. (1978). "Subsistence, Markets and Rural Development in Rural Hausaland." J. Developing Areas 12(4):449-469.

Scott, J. C. (1976). The Moral Economy of the Peasant: Rebellion and Subsistence in Southeast Asia. New Haven, Yale Univ. Press.

Scudder, T. (1973). "The Human Ecology of Big Projects: River Basin Development and Resettlement" in Siegel, Beals, and Tyler, 1973, pp. 45-61.

Scudder, T., and E. Colson. (1972). "The Kariba Dam Project: Resettlement and Local Initiative" in Bernard and Pelto, 1972, pp. 39-69.

_____. (1979). "Long-Term Research in Gwembe Valley, Zambia" in Foster, Scudder, Colson, and Kemper, pp. 227-254.

Seddon, D., ed. (1978). Relations of Production: Marxist Approaches to Economic Anthropology. London, Frank Cass.

SEDES. (1974). Introduction aux comptes economique de la production animal, application aux pays Sahelians. Tome I: etude methodologique. 2nd ed. Paris, SEDES.

Seidman, A. (1972). Comparative Development Strategies in East Africa. Nairobi, East African Publishing House.

_____. (1977). "The Economics of Eliminating Rural Poverty" in Palmer and Parsons, pp. 410-421. Reprinted in Turok, 1979, pp. 37-48.

_____. (1981). "Women and the Development of 'Underdevelopment': The African Experience" in Women and Technological Change in Developing Countries, R. Dauber and M. Cain, eds. Boulder, Colorado, Westview Press, pp. 109-126.

Seifert, W. W., and N. W. Kamrany. (1974). A Framework for Evaluating Long-Term Strategies for the Development of the Sahel-Sudan Region. Vol. I. Summary Report: Project Objectives, Methodologies and Major Findings. Cambridge, MIT, Center for Policy Alternatives.

Senegal, Government of. (1977). Food Investment Strategy, 1977-1985. Dakar, Ministry of Rural Development.

Shack, W. A., and E. P. Skinner, eds. (1979). Strangers in African Societies. Berkeley, Univ. of California Press.

Shah, M., and F. Willekens. (1978). Rural-Urban Population Projections for Kenya and Implications for Development. Laxenburg, Austria, International Institute for Applied Systems Analysis.

Shapiro, K. H. (1973). "Efficiency and Modernization in African Agriculture: A Case Study in Geita District, Tanzania." Ph.D. dissertation, Stanford Univ.

_____. (1978). "Water, Women and Development in Tanzania." Paper presented at the Third Annual Conference of the International Water Resources Association. Sao Paulo, Brazil.

_____., ed. (1979). Livestock Production and Marketing in the Entente States of West Africa: Summary Report. Ann Arbor, Univ. of Michigan, CRED.

Shapiro, K., and J. Muller. (1977). "Sources of Technical Efficiency: The Roles of Modernization and Information." Econ. Dev. and Cultural Change 25(2):293-310.

Shaw, T. W., and K. A. Heard, eds. (1979). The Politics of Africa: Dependence and Development. New York, Africana Publishing Co.

Shear, D., and B. Clark. (1976). "International Long-Term Planning for the Sahel." International Development Review 4:15-20.

Sheets, H., and R. Morris. (1974). Disaster in the Desert: Failures of International Relief in the West African Drought. Washington, Carnegie Endowment for International Peace.

Sheffield, J. R., ed. (1967). Education, Employment and Rural Development: Proceedings of a Conference Held at Kericho, Kenya. Nairobi, East African Publishing House.

Shen, T. Y. (1977). "Macro Development Planning in Tropical Africa: Technocratic and Non-Technocratic Causes of Failure." J. Development Studies 13(4):413-427.

Shepard, A. W. (1981). "Agrarian Change in Northern Ghana: Public Investment, Capitalist Farming and Famine" in Heyer, Roberts, and Williams, pp. 168-192.

Sherman, J. (1981). Crop Disposal and Grain Marketing in the Manga Region of Upper Volta: A Case Study. Ann Arbor, Univ. of Michigan, CRED, Preliminary Working Paper.

Siegel, B. J.; A. R. Beals; and S. A. Tyler, eds. (1973, 1974, 1975). Annual Review of Anthropology. Vols. 2, 3, 4. Palo Alto, California, Annual Review, Inc.

Simmons, E. B. (1975). "The Small-Scale Rural Food Processing Industry in Northern Nigeria." Food Research Institute Studies 14:147-161.

_____. (1976a). Calorie and Protein Intakes in Three Villages of Zaria Province, May 1970-July 1971. Zaria, Nigeria, Ahmadu Bello Univ., IAR, Samaru Miscellaneous Paper No. 55.

_____. (1976b). Economic Research on Women in Rural Development in Northern Nigeria. Washington, ACE, Overseas Liaison Committee.

_____. (1976c). Rural Household Expenditures in Three Villages of Zaria Province. Zaria, Ahmadu Bello Univ., IAR, Samaru Miscellaneous Paper No. 56.

Sims, M. (1981). United States Doctoral Dissertations in Third World Studies, 1869-1978. Waltham, Mass., Brandeis Univ., Crossroads Press.

Sims, M., and A. Kagan. (1976). American and Canadian Doctoral Dissertations and Master's Theses on Africa, 1886-1974. Waltham, Massachusetts, African Studies Association.

Singh, I. J. (1976). A Note on the Economics of Agricultural Mechanization. Washington, World Bank, Studies in Employment and Rural Development No. 33.

_____. (1977). "Appropriate Technologies in Tanzanian Agriculture: Some Empirical and Policy Considerations." Tanzania Basic Economic Report, Annex VII. Washington, World Bank.

Sisaye, S., and E. Stommes. (1980). "Agricultural Development in Ethiopia: Government Budgeting and Development Assistance in the Pre and Post 1975 Periods." J. Developing Areas 16(2):156-185.

Skinner, E. (1965). "Labour Migration Among the Mossi of Upper Volta" in Kuper, pp. 60-84.

Sklar, R. L. (1976). "Post-Imperialism: A Class Analysis of Multinational Corporate Expansion." Comparative Politics 9(1):75-92.

Smith, A. K., and C. E. Welch, Jr., eds. (1978). Peasants in Africa. Waltham, Massachusetts, Crossroads Press.

Smith, C. A., ed. (1976a). Regional Analysis. Vol. 1. Economic Systems. New York, Academic Press.

_____. (1976b). "Regional Economic Systems: Linking Geographical Models and Socioeconomic Problems" in C. A. Smith, 1976a, pp. 3-63.

Smith, J. A. (1978). The Development of Large-Scale Integrated Sugar Schemes in Western Kenya. Nairobi, Univ. of Nairobi, IDS Working Paper No. 343.

Smith, R. T., ed. (1978). Market-Place Trade--Periodic Markets, Hawkers and Traders in Africa, Asia and Latin America. Vancouver, Univ. of British Columbia, Center for Transportation Studies.

Smith, S. (1980). "The Ideas of Samir Amin: Theory or Tautology?" J. Development Studies 17(1):5-21.

Smith, T. (1979). "The Underdevelopment of Development Literature: The Case of Dependency Theory." World Politics 31(2):247-288.

Smith, V. E. (1975). Efficient Resource Use for Tropical Nutrition: Nigeria. East Lansing, Michigan State Univ., Graduate School of Business Administration.

Smith, V. E.; S. Lynch; W. Whelan; J. Strauss; and D. Baker. (1979). Household Food Consumption in Rural Sierra Leone. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Working Paper No. 7.

Smith, V. E.; J. Strauss; and P. Schmidt. (1981). Single-Equation Estimation of Food Consumption Choices in Rural Sierra Leone. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Working Paper No. 13.

Smith, V. E.; J. Strauss; P. Schmidt; and W. Whelan. (1980). Non-Price Factors Affecting Household Food Consumption in Sierra Leone. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Working Paper No. 12.

Smith, W. E. S. (1971). We Must Run While They Walk. New York, Random House.

Smock, D. R., and A. C. Smock. (1972). Cultural and Political Aspects of Rural Transformation: A Case Study of Eastern Nigeria. New York, Praeger.

Soligo, R. (1973). Factor Intensity of Consumption Patterns, Income Distribution, and Employment Growth in Pakistan. Houston, Texas, Rice University, Program of Development Studies Paper No. 44.

Songre, A. (1973). "Mass Emigration From Upper Volta: The Facts and Implications" in Employment in Africa: Some Critical Issues. Geneva, ILO, pp. 199-215.

Sorenson, L.; J. R. Pedersen; and N. C. Ives. (1975). Maize Marketing in Zaire. Manhattan, Kansas State Univ., Food and Feed Grain Institute, Storage, Processing, and Marketing Report No. 51.

Sorrenson, M. P. K. (1967). Land Reform in the Kikuyu Country: A Study in Government Policy. Nairobi, Oxford Univ. Press.

Southworth, V. R.; W. O. Jones; and S. R. Pearson. (1979). "Food Crop Marketing in Atebuba District, Ghana." Food Research Institute Studies 17(2):157-195.

Sparling, E. W. (1981). "A Survey and Analysis of Ex-Post Cost-Benefit Studies of Sahelian Irrigation Projects." Ft. Collins, Col., Colorado State Univ., Dept. of Econ. (Draft)

Spencer, D. S. C. (1972). Micro-Level Farm Management and Production Economics Research Among Traditional African Farmers: Lessons From Sierra Leone. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Employment Paper No. 3.

_____. (1976). African Women in Agricultural Development: A Case Study in Sierra Leone. Washington, ACE, Overseas Liaison Committee.

Spencer, D. S. C., and D. Byerlee. (1976). "Technical Change, Labor Use, and Small Farmer Development: Evidence From Sierra Leone." Amer. J. Agr. Econ. 58:874-880.

_____. (1977). Small Farms in West Africa: A Descriptive Analysis of Employment, Incomes and Productivity in Sierra Leone. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 19.

Spencer, D. S. C.; D. Byerlee; and S. Franzel. (1979). Annual Costs, Returns and Seasonal Labour Requirements for Selected Farm and Nonfarm Enterprises in Rural Sierra Leone. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 27.

Spencer, D. S. C.; I. I. May-Parker; and F. S. Rose. (1976). Employment, Efficiency and Income in the Rice Processing Industry of Sierra Leone. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Paper No. 15.

Spencer, P. (1973). Nomads in Alliance: Symbiosis and Growth Among the Rendille and Samburu of Kenya. London, Oxford Univ. Press.

Spencer, W. P.; D. L. Pfost; and J. R. Pedersen. (1975). Grain Storage and Preservation in Senegal. Manhattan, Kansas State Univ., Food and Feed Grain Institute, Storage, Processing, and Marketing Report No. 54.

Staatz, J. (1979). The Economics of Cattle and Meat Marketing in the Ivory Coast. Ann Arbor, Univ. of Michigan, CRED, Livestock Production and Marketing in the Entente States of West Africa, Monograph 2.

_____. (1980). "Meat Supply in Ivory Coast, 1967-1985" in Ariza-Nino and Steedman, 1980, pp. 1-210.

Staudt, K. (1975). "Women Farmers and Inequalities in Agricultural Services." Rural Africana 29:81-94.

Stavis, B. (1979). Agricultural Extension for Small Farmers. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Working Paper No. 3.

Steedman, C., et al. (1976). Mali: Agricultural Sector Assessment. Final Report. Ann Arbor, Univ. of Michigan, CRED.

Steel, W. F. (1977). Small-Scale Employment and Production in Developing Countries: Evidence From Ghana. New York, Praeger.

_____. (1979). "Development of the Urban Artisanal Sector in Ghana and Cameroun." J. Modern African Studies 17(2):271-284.

Steeves, J. S. (1978). "Class Analysis and Rural Africa: The Kenya Tea Development Authority." J. Modern African Studies 16(1):123-132.

Stein, L. (1979). The Growth of East African Exports and Their Effect on Economic Development. London, Croom Helm.

Stenning, D. J. (1957). "Transhumance, Migratory Drift, Migration: Patterns of Pastoral Nomadism." J. Royal Anthropological Institute 87:57-73.

_____. (1959). Savannah Nomads: A Study of the WoDaaBe Pastoral Fulani of Western Bornu Province, Northern Region, Nigeria. London, Oxford Univ. Press for the International African Institute.

Stern, N. H. (1972). "Experience With the Use of the Little Mirrlees Method for an Appraisal of Small-Holder Tea in Kenya." Oxford Bulletin Econ. and Stat. 34(1):93-123.

Stern, R. (1965). "The Determinants of Cocoa Supply in West Africa" in Stewart and Ord, 1965, pp. 65-82.

Stevens, C. (1979). Food Aid and the Developing World -- Four African Case Studies. New York, St. Martin's Press.

Stevens, P., Jr., ed. (1978). The Social Sciences and African Development Planning. Waltham, Massachusetts, Crossroads Press.

Stewart, F. (1979). "Employment and the Choice of Technique: Two Case Studies in Kenya" in Ghai and Godfrey, 1979, pp. 47-74.

Stewart, I. G.; R. C. Ogley; and W. D. C. Wright. (1962). Nigeria: Determinants of Projected Level of Demand, Supply and Imports of Farm Products in 1965 and 1975. Washington, USDA.

Stewart, I. G., and H. W. Ord, eds. (1965). African Primary Products and International Trade. Edinburgh, Edinburgh Univ. Press.

Stolper, W. F. (1969). Planning Without Facts: Lessons in Resource Allocation From Nigeria's Development. Cambridge, Harvard Univ. Press.

Stoltz, D. (1979). "Smallholder Dairy Development in Past, Present and Future in Kenya." Ph.D. dissertation, Univ. of Hohenheim.

Storm, R. (1976). "Government Cooperative Groundnut Marketing in Senegal and Gambia." J. Rural Cooperation 5(1):29-42.

Stout, B. A., and C. M. Downing. (1976). "Agricultural Mechanization Policy." International Labour Review 113:171-187.

Strauss, J. (1981). "Determinants of Household Food Consumption in Sierra Leone: Estimation of a Household-Firm Model with Application of the Quadratic Expenditure System." Ph.D. dissertation, Michigan State Univ.

Streeten, P. (1972). "Single Barrier Theories of Development." The Frontier of Development Studies. London, Macmillan, pp. 13-20.

Stryker, J. D. (1974). "The Malian Cattle Industry: Opportunity and Dilemma." J. Modern African Studies 12:441-457.

Sudan, Democratic Republic of. (1977). Food Investment Strategy, 1977-1985. Khartoum, Ministry of Agriculture, Food, and Natural Resources.

Sudarkasa, N. (1973). Where Women Work: A Study of Yoruba Women in the Marketplace and in the Home. Ann Arbor, Univ. of Michigan, Museum of Anthropology, Paper No. 53.

Sukhatme, P. V. (1970). "Incidence of Protein Deficiency in Relation to Different Diets in India." British J. Nutrition 24:477-487.

Sundstrom, L. (1974). The Exchange Economy of Pre-Colonial Tropical Africa. London, C. Hurst.

Suret-Canale, J. (1971). French Colonialism in Tropical Africa, 1900-1945. Translation by T. Gottheiner. New York, Crea Press.

Swamy, G. (1981). International Migrant Workers' Remittances: Issues and Prospects. Washington, World Bank, Staff Working Paper No. 481.

Swanson, R. A. (1980). "Development Interventions and Self-Realization Among the Gourma (Upper Volta)" in Brokensha, Warren, and Werner, pp. 67-92.

_____. (1981). Household Composition, Rainfall and Household Labor Time Allocation for Planting and Weeding: Some Observations and Recommendations. Ouagadougou, Upper Volta, SAFGRAD, Farming Systems Unit, Document No. 4.

Swift, J. (1975). "Pastoral Nomadism as a Form of Land-Use: The Twareg of the Adrar n Iforas (Mali)" in Monod, pp. 443-454.

_____. (1977). "Sahelian Pastoralist: Underdevelopment, Desertification and Famine." Annual Rev. Anthropology 6:457-478.

_____. (1981). "Seeds of Famine: A Review." Science 211:473-474.

Swindell, K. (1978). "Family Farms and Migrant Labour: The Strange Farmers of the Gambia." Canadian J. African Studies 12(1):3-17.

Szal, R. J. (1979). Income Inequality and Fiscal Policies in Botswana. Geneva, ILO, Income Distribution and Employment Programme Working Paper No. 73.

Szereszewski, R. (1961). Structural Change in the Economy of Ghana, 1891-1911. London, Weidenfield and Nicholson.

Talbot, L. M. (1972). "Ecological Consequences of Rangeland Development in Masailand, East Africa" in Farvar and Milton, 1972, pp. 694-711.

Tapsoba, E. (1981). "An Economic and Institutional Analysis of Formal and Informal Credit in Eastern Upper Volta: Empirical Evidence and Policy Implications." Ph.D. dissertation, Michigan State Univ.

Taylor, B. R., and T. B. Bailey. (1979). "Response of Maize Varieties to Environment in West Africa." Tropical Agriculture 56(2):89-97.

Tecle, T. (1975). The Evolution of Alternative Rural Development Strategies in Ethiopia: Implications for Employment and Income Distribution. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Employment Paper No. 12.

Tempelman, A. (1972). "The Economics of Rice Milling in the Western State of Nigeria. Ibadan, Nigeria, NISER, mimeographed.

Temu, P. (1975). "Marketing Board Pricing and Storage Policy With Particular Reference to Maize in Tanzania." Ph.D. dissertation, Stanford Univ.

Tench, A. B. (1975). Socio-Economic Factors Influencing Agricultural Output--With Special Reference to Zambia. Saarbrucken, Verlag des SSIP-Schriften.

Terray, E. (1972). Marxism and Primitive Societies. Part 2. Historical Materialism and Segmentary Lineage-Based Societies. Translation by M. Klopper. New York, Monthly Review Press, pp. 93-186.

Terry, E.; K. Oduro; and F. Caveness, eds. (1981). Tropical Root Crops: Research Strategies for the 1980s. Ottawa, Canada, IDRC.

Thenevin, P. (1978). L'investigation en milieu rural et la pratique du developpement (Cadre d'integration et approche systemique). Paris, INSEE, AMIRA note de travail No. 18.

_____. (1980). "L'aide alimentaire en cereales dans les pays Saheliens." Paris, Ministre de la Cooperation, Service des Etudes et Questiones Internationales.

Thodey, A. R. (1969). Marketing of Grains and Pulses in Ethiopia. Menlo Park, California, Stanford Research Institute.

Thornton, D. S. (1973). Agriculture in South East Ghana. Vol. I. Summary Report. Reading, Univ. of Reading, Dept. of Agr. Econ. and Mgt.

Thornton, D. S., and R. F. Wynn. (1968). "An Economic Assessment of the Sudan's Khasm el Girba Scheme." East African J. Rural Development 1(2):1-21.

Tiffen, M. (1976). The Enterprising Peasant: Economic Development in Gombe Emirate, North Eastern State, Nigeria, 1900-1968. London, Her Majesty's Stationary Office, Ministry of Overseas Development.

Timmer, C. P. (1970). "On Measuring Technical Efficiency." Food Research Institute Studies 9(2):99-171.

_____. (1972). "Employment Aspects of Investment in Rice Marketing in Indonesia." Food Research Institute Studies 11:59-88.

Tinker, I. (1976). "The Adverse Impact of Development on Women" in Women and World Development, with an Annotated Bibliography, I. Tinker, M. B. Bramsen, and M. Buvinic, eds. New York, Praeger, pp. 22-34.

Todaro, M. P. (1969). "A Model of Labour Migration and Urban Unemployment in Less Developed Countries." Amer. Econ. Rev. 59:138-148.

_____. (1976). Internal Migration in Developing Countries: A Review of Theory, Evidence, Methodology and Research Priorities. Geneva, ILO.

_____. (1980). "Internal Migration in Developing Countries: A Survey" in Easterlin, pp. 361-402.

Toksoz, S. (1981). An Accelerated Irrigation and Land Reclamation Program for Kenya: Dimensions and Issues. Cambridge, Harvard Univ., Harvard Institute for International Development, Development Discussion Paper No. 114.

Toupet, C. (1977). La sedentarisation des nomades en Mauritanie centrale Sahelienne. Paris, Librairie Honore Champion.

Tourte, R. (1974). "Reflexions sur les voies et moyens d'intensification de l'agriculture en Afrique de l'Ouest." L'Agronomie Tropicale 24(9):917-946.

Tourte, R., et. al. (1971). "Themes legers--themes lourds: systems intensifs: voies differentes ouvertes au developpement agricole du Senegal." L'Agronomie Tropicale 26:632-671.

Traore, B. (1980). "Socioeconomic Field Assessment of Prospective Technologies in the SAT of Mali: A Case Study in an OACV Zone" in ICRISAT, 1980a, pp. 125-135.

Traore, N., and M. Toure. (1978). "Le machinisme agricole au Mali." Journees d'etudes technico-economiques sur le tracteur Swazi Tiukabi. Bamako, Mali, CEPI et DMA.

Tripp, R. (1978). "Economic Strategies and Nutritional Status in a Compound Farming Settlement of Northern Ghana." Ph.D. dissertation, Columbia Univ.

Truong Binh; J. Pichot; and P. Beunard. (1978). "Caracterisation et comparison des phosphates naturels tricalciques d'Afrique de l'Ouest en vue de leur utilisation directe en agriculture." L'Agronomie Tropicale 33:136-145.

Tryfos, P. (1974). "Canadian Supply Functions for Livestock and Meat." Amer. J. Agr. Econ. 56(1):107-113.

Turok, B., ed. (1979). Development in Zambia: A Reader. London, Zed Press.

Tyc. (1975). L'elevage en Haute Volta: analyse et proposition d'orientation. Paris, SEDES.

Uchendu, V. C. (1967). "Some Issues in African Land Tenure." Tropical Agriculture 44(2):91-101.

_____. (1968). "Socioeconomic and Cultural Determinants of Rural Change in East and West Africa." Food Research Institute Studies 8(3):225-242.

Uchendu, V. C., and K. R. Anthony. (1975a). Agricultural Change in Kisii District, Kenya. Nairobi, East African Literature Bureau.

_____. (1975b). Agricultural Change in Teso District, Uganda. Nairobi, East African Literature Bureau.

Uhlig, S. J., and B. A. Bhat. (1979). Choice of Technique in Maize Milling. Edinburg, Scottish Academic Press.

UN. (1981). World Population Prospects as Assessed in 1980. New York, United Nations Secretariat, Population Division.

UN ECA. (1971). Africa's Strategy for Development in the 1970s: First Conference of Ministers of the Economic Commission for Africa. New York.

UN/ECA/FAO. (1964). Report of the FAO/ECA Expert Meeting on Government Measures to Promote the Transition From Subsistence to Market Agriculture in Africa, Addis Ababa, 27 April - 7 May 1964. Rome, FAO.

_____. (1966). African Agricultural Development: Reflections on the Major Lines of Advance and the Barriers to Progress. New York, United Nations.

Unite d'Evaluation. (1978). Evaluation de l'operation arachide et cultures vivrieres. Etude agro-economique de 32 exploitations agricoles en zone OACV. Bamako, Mali, IER.

USDA, ERS. (1981). Food Problems and Prospects in Sub-Saharan Africa: The Decade of the 1980's. Washington, USDA, Foreign Agricultural Research Report No. 166.

University of Nairobi. (1975). Second Overall Evaluation of the Special Rural Development Programme. Nairobi, Univ. of Nairobi, IDS, Occasional Paper No. 12.

Upton, M. (1967). Agriculture in South-West Nigeria: A Study of the Relationship Between Production and Social Characteristics in Selected Villages. Reading, Univ. of Reading, Development Studies Paper No. 3.

_____. (1970). "The Influence of Management on a Sample of Nigerian Farms." Farm Economist 11:526-536.

_____. (1973). Farm Management in Africa: The Principles of Production and Planning. London, Oxford Univ. Press.

_____. (1979). "The Unproductive Production Function." J. Agr. Econ. 30(2):179-194.

Upton, M., and H. Casey. (1974). "Risk and Some Pitfalls in the Use of Averages in Farm Planning." J. Agr. Econ. 25:147-152.

Upton, M., and D. H. Petu. (1964). "An Economic Study of Farming in Two Villages in Illorin Emirate." Bulletin Rural Econ. and Sociology 1(1):7-30.

Urdang, S. (1980). Fighting Two Colonialisms: Women in Guinea - Bissau. New York, Monthly Review Press.

Vadlamundi, Y. R., and H. U. Thimm. (1974). "Economic Analysis of Fertilizer Trials Conducted in Kenya on Maize." East African Agr. and Forestry J. 40(2):189-201.

Vail, D. J. (1973). "Induced Farm Innovation and Derived Scientific Research Strategy." East African J. Rural Development 6(1).

Valdes, A., ed. (1981). Food Security for Developing Countries. Boulder, Colorado, Westview Press.

Van Apeldoorn, G. J. (1971). Markets in Ghana--A Census and Some Comments. Vol. 1. Northern and Upper Regions. Legon, Univ. of Ghana, ISSER, Technical Publication No. 17.

Van Binsbergen, W. M. J., and H. A. Meilink, eds. (1978). Migration and the Transformation of Modern African Society. Leiden, Netherlands, Afrika-Studiecentrum, African Perspectives, 1978/1.

Van der Hoeven, R. (1977). Zambia's Income Distribution During the Early Seventies. Geneva, ILO, Income Distribution and Employment Programme Working Paper No. 54.

Van der Wiel, A. C. A. (1977). Migratory Wage Labour: Its Role in the Economy of Lesotho. Mazenod, Lesotho, Mazenod Book Center.

Van Ginneken, W. (1976). Rural and Urban Income Inequalities in Indonesia, Mexico, Pakistan, Tanzania and Tunisia. Geneva, ILO.

Van Hekken, N., and H. U. E. T. Van Velzen. (1972). Land Scarcity and Rural Inequality in Tanzania: Some Case Studies from Rungwe District. The Hague, Netherlands, Mouton.

Van Raay, H. G. T. (1975). Rural Planning in a Savanna Region. Rotterdam, Rotterdam Univ. Press.

Van Rensburg, P. (1978). The Serowe Brigades: Alternative Education in Botswana. London, MacMillan.

Vasthoff, J. (1968). Small Farm Credit and Development: Some Experiences in East Africa with Special Reference to Kenya. Munich, West Germany, Weltforum Verlag.

Venema, L. B. (1978). The Wolof of Saloum: Social Structure and Rural Development in Senegal. Wageningen, Netherlands, Center for Agriculture Publications and Documentation, Agricultural Research Report No. 871.

Vengroff, R. (1977). "Dependency and Underdevelopment in Black Africa: An Empirical Test." J. Modern African Studies 15(4):613-630.

Vermeer, D. E. (1970). "Population Pressures and Crop Rotational Changes Among the Tiv of Nigeria." Annals, Association of American Geographers 60:299-314.

_____. (1979). "The Tradition of Experimentation in Swidden Agriculture Among the Tiv of Nigeria" in Applied Geography Conferences, Vol. 2, J. M. Frazier and B. J. Epstein, eds. Bingham, New York, SUNY-Bingham.

_____. (1981). "Collision of Climate, Cattle and Culture in Mauritania During the 1970s." Geographical Rev. 71(3):281-297.

Vinay, B. (1968). L'Afrique commerce avec l'Afrique: problems et imperatifs Africains de cooperation economique et monetaire. Paris, Presses Universitaires de France.

Von Freyhold, M. (1979). Ujamaa Villages in Tanzania: Analysis of a Social Experiment. New York, Monthly Review Press.

Von Kaufmann, R. (1976). "The Development of the Range Land Areas" in Heyer, Maitha, and Senga, pp. 255-287.

Von Pischke, J. D. (1980). "The Political Economy of Specialized Farm Credit Institutions" in J. Howell, pp. 81-103. (Also available as World Bank Working Paper No. 446, 1981, Washington.)

Wallace, T. (1981). "The Kano River Project, Nigeria: The Impact of an Irrigation Scheme on Productivity and Welfare" in Heyer et al., 1981, pp. 281-305.

Wardle, C. (1979). Promoting Cattle Fattening Among Peasants in Niger. London, ODI, Pastoral Network Paper No. 8c.

Warren, A., and J. K. Maizels. (1977). "Ecological Change and Desertification." UN Conference on Desertification. Desertification: Its Causes and Consequences. Oxford, Pergamon Press, pp. 169-260.

Watts, E. R. (1969). "Bureaucracy and Extension." East African J. 6(8):37-40.

Weber, A., and T. T. Hartmann. (1977). "A Comparative Study of Economic Integration With Special Reference to Agricultural Policy in the East African Community" in Dams and Hunt, pp. 379-395.

Weigel, J. Y. (1980). "Irrigation and Socio-Economic Systems of the Sominke in the Bakel Region (Senegal River Valley)" in Purdue Univ., 1980.

Weil, P. (1970). "The Introduction of the Ox Plow in Central Gambia" in McLoughlin, pp. 229-263.

_____. (1980). "Land Use, Labor and Intensification Among the Mandinka of Eastern Gambia." (Paper presented at the Annual Meeting of the African Studies Association, October 15-18.) Philadelphia.

Weiler, E. (1979). "Social Cost-Benefit Analysis of the Nianga Project, Senegal." M.S. Thesis, Purdue Univ.

Weinrich, A. K. H. (1975). African Farmers in Rhodesia: Old and New Peasant Communities in Karangaland. New York, Oxford Univ. Press.

Wells, J. C. (1974). Agricultural Policy and Economic Growth in Nigeria, 1962-68. Ibadan, Nigeria, Oxford Univ. Press.

Welsch, D. E. (1965). "Response to Economic Incentives by Abakaliki Rice Farmers in Eastern Nigeria." J. Farm Econ. 47:900-914.

_____. (1966). "Rice Marketing in Eastern Nigeria." Food Research Institute Studies 6(3):329-352.

Westley, S., and B. F. Johnston, eds. (1975). Proceedings of a Workshop on Farm Equipment Innovations for Agricultural Development and Rural Industrialization. Nairobi, Univ. of Nairobi, IDS Occasional Paper No. 16.

Westley, S.; B. F. Johnston; and M. David. (1975). Summary Report of a Workshop on a Food and Nutrition Strategy for Kenya. Nairobi, Univ. of Nairobi, IDS Occasional Paper No. 14.

Whetham, E. H. (1972). Agricultural Marketing in Africa. London, Oxford Univ. Press.

Whetham, E. H., and J. I. Currie, eds. (1967). Readings in the Applied Economics of Africa. 2 vols. London, Cambridge Univ. Press.

Whitney, A. (1968). Marketing of Staple Foods in Eastern Nigeria. East Lansing, Michigan State Univ., Dept. of Agr. Econ., Agricultural Economics Report No. 114.

Whitney, T. R. (1981). "Changing Patterns of Labor Utilization, Productivity and Income: The Effects of Draft Animal Technology on Small Farms in Southeastern Mali." Unpublished M.Sc. Thesis, Purdue Univ.

WHO. (1976). Methodology of Nutritional Surveillance. Geneva, WHO, Report of a Joint FAO/UNICEF/WHO Expert Committee.

Whyte, W. F. (1981). Participatory Approaches to Agricultural Research and Development: A State-of-the-Art Paper. Ithaca, N.Y., Cornell Univ., Rural Development Committee, ARE No. 1.

Widstrand, C. G., ed. (1971). Co-operatives and Rural Development in East Africa. New York, Holmes and Meier.

_____. (1972). African Co-operatives and Efficiency. Uppsala, Scandinavian Institute of African Studies.

_____. (1975). Multinational Firms in Africa. Stockholm, Almquist and Wiksell.

Wilcock, D. C. (1978). The Political Economy of Grain Marketing and Storage in the Sahel. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 24.

_____. (1981). Small-Scale, Non-Farm Enterprises in Eastern Upper Volta: Survey Results. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 36.

Williams, G. (1981). "The World Bank and the Peasant Problem" in Heyer, Roberts, and Williams, pp. 16-51.

Wilson, F. (1972). Labour in the South African Gold Mines, 1911-1969. Cambridge, Cambridge Univ. Press.

Winch, F. (1976). "Costs and Returns of Alternative Rice Production Systems in Northern Ghana: Implications for Output, Employment and Income Distribution." Ph.D. dissertation, Michigan State Univ.

Winter, G. (1970). Methodologie des enquetes niveau de vie en milieu rural Africain. Paris, ORSTOM, Initiatives et documents techniques No. 15.

_____. (1975). Le point de vue du planificateur sur le probleme de l'amelioration des methodes d'investigation en milieu rural Africain. Paris, INSEE, AMIRA note de travail No. 2.

_____. (1978). Reflexion sur les enquetes-menages a fins multiples dans les pays en voie de developpement. Paris, INSEE, AMIRA note de travail no. 21.

Wolf, E. (1969). Peasant Wars of the Twentieth Century. New York, Harper and Row.

Wolgin, J. M. (1975). "Resource Allocation and Risk: A Case Study of Smallholder Agriculture in Kenya." Amer. J. Agr. Econ. 57:622-630.

_____. (1979). "Resource Allocation and Risk: A Case Study of Smallholder Agriculture in Kenya: Reply." Amer. J. Agr. Econ. 61:114-115.

Wolpe, H. (1972). "Capitalism and Cheap Labour Power in South Africa: From Segregation to Apartheid." Economy and Society 1(4):425-456.

Wood, L. J. (1974). Market Origins and Development in East Africa. Kampala, Makerere Univ., Dept. of Geography, Occasional Paper No. 57.

World Bank. (1980). World Development Report, 1980. Washington.

_____. (1981a). World Development Report, 1981. Washington.

_____. (1981b). Accelerated Development in Sub-Saharan Africa: An Agenda for Action. Washington.

Wrigley, C. C. (1965). "Kenya's Pattern of Economic Life, 1902-45" in History of East Africa, II, V. Harlow and E. M. Chilver, eds. London, Oxford Univ. Press, pp. 209-264.

Wuyts, M. (1981). "The Mechanization of Present-Day Mozambican Agriculture." Development and Change 12(1):1-27.

Yansane, A. Y. (1976). "An Evaluation of Socialist Experiments in African States of French Colonial Legacy." Nigerian J. Econ. Soc. Studies 18(3):363-407.

Yap, L. Y. L. (1977). "The Attraction of Cities: A Review of the Migration Literature." J. Dev. Econ. 4:239-264.

Young, D. L. (1979). "Resource Allocation and Risk: A Case Study of Smallholder Agriculture in Kenya: Comment." Amer. J. Agr. Econ. 61:111-113.

Young, M. D. (1979). "Influencing Land Use in Pastoral Australia." J. Arid Environments 2:279-288.

Young, S. (1977). "Fertility and Famine: Women's Agricultural History in Southern Mozambique" in Palmer and Parsons, pp. 66-81.

Youngs, A. J. (1972). "Wheat Flour and Bread Consumption in West Africa: A Review with Special Reference to Ghana." Tropical Science 14(3):235-244.

Yudelman, M. (1975). "Imperialism and the Transfer of Agricultural Techniques" in Duignan and Gann, pp. 329-359.

Zachariah, K. C., and J. Conde. (1980). Migration in West Africa: Demographic Aspects. New York, Oxford Univ. Press for the World Bank and OECD.

Zalla, T. (1981). "Political, Technical and Economic Aspects of Smallholder Milk Production in Northern Tanzania." Ph.D. dissertation, Michigan State Univ.

Zalla, T.; D. J. Campbell; J. Holtzman; L. Lev; and D. Trechter. (1981). Agricultural Production Potential in the Mandara Mountains in Northern Cameroon. East Lansing, Michigan State Univ., Dept. of Agr. Econ., MSU Rural Development Working Paper No. 17.

Zalla, T.; R. B. Diamond; and M. S. Mudahar. (1977). Economic and Technical Aspects of Fertilizer Production and Use in West Africa. East Lansing, Michigan State Univ., Dept. of Agr. Econ., African Rural Economy Working Paper No. 22; and Muscle Shoals, Ala., International Fertilizer Development Center.

Zerbo, D., and M. Le Moigne. (1977). "Problemes poses par la mecanisation dans les pays membres du CILSS." Antony, France, CEEMAT.

Zimbabwe, Government of the Republic. (1980). Zimbabwe Research Index, 1979. Salisbury, Government Printer.

_____. (1981). Growth with Equity: An Economic Policy Statement. Salisbury, Government Printer.

Zolberg, A. R. (1967). "The Political Use of Economic Planning in Mali" in Economic Nationalism in Old and New States, H. C. Johnson, ed. Chicago, Univ. of Chicago Press, pp. 98-123.

Zuckerman, P. S. (1977). "Different Smallholder Types and Their Development Needs." J. Agr. Econ. 28:119-128.

_____. (1979a). A Micro-Level Farm Management Study in Western Nigeria: Field Work Design and Application. Ibadan, Nigeria, IITA, Discussion Paper No. 7/79.

_____. (1979b). A Micro-Level Farm Management Study in Western Nigeria: Some Results and Experiences with Questionnaires. Ibadan, Nigeria, IITA, Discussion Paper No. 8/79.

_____. (1979c). "Simulating the Decision Making of a Nigerian Smallholder." Canadian J. Agr. Econ. 27(2):17-26.