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AGRICULTURAL RESEARCH POLICY IN NIGERIA⁺

by

Professor F. S. Idachaba,
Department of Agricultural
Economics,
University of Ibadan.

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I. INTRODUCTION

Recent performance of Nigerian agriculture especially in the last decade has not been impressive. Agricultural GDP in real terms declined at an annual rate of 0.4 percent during 1960 - 70 (1960 base year) and at an annual rate of 1.1 percent during 1970 - 80 (1970 base year). The corresponding growth rates for industry during the same periods were 16.0 and 11.3 percent respectively, while overall GDP grew at 3.1 and 5.7 percent, respectively, over the same periods.⁽¹⁾ Table 1 shows growth performance of selected sectors in recent years. Nigeria has moved from being a net exporter to a large importer of groundnuts, palm oil and cotton.

Demand pressures on available food supplies have resulted in soaring domestic food prices and imports in recent years, especially for those foodstuffs with income elastic demands. Phenomenal increases in food imports to meet the shortfall in domestic production are illustrated in Tables 2 and 3. In 1982, imports of rice, wheat and maize had reached 625,000 tonnes, 1.5 million tonnes and 500,000 tonnes respectively.

Sources of decline in food production include falling trends in productivity, a succession of adverse macro-economic policies and the failure of the national agricultural

* Invited Paper Presented at Agricultural Research Policy Seminar, University of Minnesota, Minneapolis/St. Paul, U.S.A., April 22, 1986.

(1) Federal Office of Statistics, Lagos.

TABLE 1: Growth Rates of Selected Sectors of the Nigerian Economy in Real Terms, 1973/74 - 1980/81

Growth Rates (%) in:

	1973/ 74- 74/75	1974/ 75- 75/76	1975/ 76- 76/77	1976/ 77- 77/78	1977/ 78- 78/79	1978/ 79- 79/80	1979/ 80	1980- 81
1. Agriculture	10.5	-10.5	0.0	6.0	8.0	-2.0	-1.0	-3.0
2. Crude Petroleum	25.0	-22.0	19.0	1.0	9.0	16.0	-8.0	-13.0
3. Wholesale and Retail Trade	7.0	14.0	7.0	11.0	8.0	11.0	0.0	0.0
4. Building and Construction	0.0	0.0	33.0	17.0	4.0	3.0	10.0	5.0
5. Manufacturing (Largescale)	-3.0	23.0	24.0	7.0	14.0	7.0	18.0	12.0

Source:- Nigeria Gross Domestic Product and Allied Macro-Aggregates (1973/74 - 81), Vol. 1 No. 1, April 1982,
Federal Office of Statistics, Lagos.

Table 2: Effects of Income Windfalls on Selected Food Imports, 1974 - 76

(Tonnes)

ITEM	PRE-UDJOI SALARY AWARDS & ARREARS			POST-UDJOI SALARY AWARDS & ARREARS		
	1972	1973	1974	1975	1976	1977
<u>A. Cereals</u>						
Wheat	11630	108847.18	318269	407309	733133	719665
Rice	232	26615	4805	6652	45377	413272
Maize	374	722	2440	2211	9861	36813
<u>B. Meat</u>						
Fresh or Frozen	548	17	445	3710	13764	22326
Milk	3056	62708	67299	85924	99540	148463
Butter & Cheese	30	570	862	1532	2341	2344
<u>C. Sea Foods</u>						
Fresh and Simply preserved	181	4560.8	6641	17291	3770	31256
Canned or prepared	282	8167	8060	22706	47760	63824

Source: Federal Office of Statistics, Nigeria Trade Summary (Various issues).

Table 3: Mean Annual Imports of Selected Food Imports, 1960 - 1980

Food Item	MEAN ANNUAL IMPORTS (₦)				Percentage Change 1967/70 - 1976/79
	1960 - 1966	1967 - 1970	1971 - 1975	1976 - 1979	(%)
Poultry	55,983.57	166,399.00	404,369.60	3,418,178.50	
Meat	690,918.43	140,177.50	8,391,402.20	20,160,618.00	
Milk & Cream	5,462,423.14	9,136,040.00	30,383,907.40	101,922,870.00	
Butter	284,133.86	123,751.00	524,224.80	1,679,512.50	
Cheese	248,120.00	241,026.00	636,907.20	1,378,132.20	
Eggs	89,999.43	11,747.00	44,429.80	244,245.80	
Stockfish	14,031,425.57	3,468,435.00	6,555,050.60	26,819,925.00	
Sadines	n.a.	371,895.50	2,761,378.80	36,494,202.00	
Wheat	4,675,562.57	10,812,028.50	37,136,038.80	98,917,365.00	
Rice	225,124.00	130,543.00	1,035,907.20	130,678,900.00	
Maize	12,472.86	233,232.50	393,185.40	11,603,603.00	
Fruits	1,438,625.57	698,928.00	1,462,492.60	806,071.75	
Vege- tables	1,404,555.43	1,368,271.00	3,932,485.40	3,657,353.20	
Alcohol- lic	3,927,816.43	1,748,131.25	12,670,744.80	29,597,475.00	
Beverages*					

Note *Included only for comparison

Source: Original data from Federal Office of Statistics,
Nigeria Trade Summary (Various Issues).

research system to transform modes of production. Why, after almost one century of agricultural research has the Nigerian agricultural research system not succeeded in significantly raising total or partial productivity?

This paper examines salient features of agricultural research policy in Nigeria since the turn of the century. Specifically, the paper:

(a) reviews the historical evolution of agricultural research policy in Nigeria (b) examines the meaning of agricultural research policy within a developmental context (c) analyses agricultural research resource allocation priorities, and (d) identified the key issues in agricultural research policy in a developing economy.

The Nigerian experience should throw up lessons of importance for other African countries for at least three reasons: first, it is a large country spanning different ecological zones needing differentiated agricultural research outputs; second, development phases of the agricultural research system are closely related to the country's agricultural development experience, a replica of agricultural development systems on the African continent and finally, Nigeria devotes relatively large amounts resources to agricultural research. The historical evolution of Nigeria's agricultural research system is presented in Section II while the key issues in agricultural research policy in a developing country are presented in Section III. Section IV contains the Summary and Conclusions.

II. HISTORICAL EVOLUTION OF NIGERIA'S NATIONAL AGRICULTURAL RESEARCH SYSTEM

Government involvement in agricultural research dates back to 1893 when a botanical research station was established in Lagos. By 1905, the British Empire Cotton Growing Corporation had begun active research at Moor Plantation, only to abandon it five years later when the area was found to be unsuitable for cotton production. By 1910, Moor Plantation became the headquarters of the Department of Agriculture. The 1954 Constitution placed "scientific and industrial" research on the concurrent list. Consequently, the research facilities at Moor Plantation were shared between federal and western regional governments. The Federal Department of Agricultural Research, established in Moor Plantation, was to conduct research into maize, rice, horticultural crops, sugar-cane and tree crops. The Federal Department of Agricultural Research became the National Cereals Research Institute (NCRI) in 1975.

With the 1954 federal constitution and the regionalization of agriculture, the Provincial Experimental Farm, started in 1923 at Umudike, was absorbed by the Eastern Region Department of Agriculture in 1955. In 1956, it was converted into the Eastern Nigeria Agricultural Research Station. The Station was taken over by the federal government in 1972 and was renamed the National Root Crops Research Institute (NRCRI) in 1975.

In the northern region, a Regional Research Station was established at Samaru in 1922 as the headquarters of the Department of Agriculture of the Northern Provinces. During 1922 - 57, Samaru served as the research arm of the Department and in 1962 the Research and Specialist Services Division of the Northern Nigeria Ministry of Agriculture and Natural Resources at Samaru was transferred to the newly established Ahmadu Bello University. In October 1962, the Institute for Agricultural Research and Special Services was created, administratively and professionally part of the University while at the same time maintaining its link with the Northern Regional Ministry of Agriculture, with a mandate to conduct research into all aspect of agriculture in Northern Nigeria. In 1975, the institute simply became the Institute for Agricultural Research (IAR), with the Special Services Section excised to constitute an autonomous Agricultural Extension and Research Liaison Service (AERLS).

The Institute of Agricultural Research and Training (IAR&T) dates back to 1956 when the Federal and Western Regional Governments shared out the research facilities at Moor Plantation following the regionalization of agriculture. It became part of the newly established University of Ife in 1962 and was taken over by the federal government in 1975.

In horticultural crops, both the Northern Research Station and the Federal Department of Agricultural Research maintained a continuing interest beginning in the 1940s and 1950s. For example, the first annual report of the Unified

Northern Research Station (1952/53) listed three investigations into "ornamental shrubs", "vegetable trees" and "citrus and other fruits". But it was not until 1975 that the National Horticultural Research Institute was created by the federal government from an ongoing project of the UNDP - FAO.

The Nigerian Stored Products Research Institute (NSPRI) was created after the dissolution of the West African Research Organization which saw the demise of the precursor, the West African Stored Products Research Institute (WACRI). NSPRI was formally established in 1977.

In tree crops, the West African Cocoa Research Institute was established in Tafo, Ghana in 1944 to serve the cocoa economies of Southern Ghana, Nigeria and other British West African countries. The Cocoa Research Institute of Nigeria (CRIN) was created in 1964 to replace the existing Nigerian substation of WACRI, with a widened mandate to include research on cocoa, coffee, kola and cashew.

The Oil Palm Research Station was established in 1939 to help Nigeria meet competition from other oil palm producing countries of the Far East. It was replaced by the West African Institute for Oil Palm Research (WAIFOR) in 1951 for the purposes of undertaking research into problems and matters relating to the oil palm and its products and for the provision of information and advice relating to the oil palm. The Nigerian Institute of Oil Palm Research (NIFOR) was established in 1964 to replace WAIFOR which had been scrapped in 1962.

The Rubber Research Station dates back to 1961. In 1971, the Rubber Research Institute was created by the Federal Government.

Research into forestry was originally part of the old Department of Forestry. With the 1954 constitution, forestry, like agriculture, became regionalized and the Federal Department of Forestry Research was established at Ibadan. In 1975, the Forestry Research Institute of Nigeria (FRIN) was

established to conduct research into forestry and the conservation of wild flora and fauna.

In livestock research, the 1954 constitution resulted in the creation of Regional Veterinary Departments and the Federal Department of Veterinary Research to conduct research and produce livestock vaccines for the Regional veterinary departments and other West African countries. In 1975, the National Veterinary Research Institute (NVRI) was established.

Animal production research began with the establishment of the Shika Stock Farm in 1927 and the launching of animal breeding experiments in 1928. In 1975, the National Animal Production Research Institute (NAPRI) was established.

The West African Institute for Trypanosomiasis Research was established in 1947 to serve the needs of Nigeria, Ghana, Sierra Leone and Gambia in research on human and animal trypanosomiasis. The Nigerian Institute for Trypanosomiasis Research (NITR) was created in 1964 with the dissolution of the West African Research Organization in 1962. The Leather Research Institute of Nigeria (LRIN) was created in 1975 out of the FAO Hides and Skins Demonstration and Training Project started in 1964.

In fisheries research, the Kainji Lake Research Institute, established in 1975, had its origins in a UNDP/FAO project to conduct research in the fields of agriculture, public health, fisheries, limnology and socioeconomics as these affected the lives of people resettled around Lake Kainji. Finally, the Nigerian Institute for Oceanography and Marine Research (NIOHR) was created in 1975 to handle all aspects of oceanographic and marine research in Nigeria. The country now has eighteen agricultural research institutes (see Table 4).

Laws and Decrees Establishing Research Institute

Upon the dissolution of the West African Research Organization in 1962, the Nigerian Research Institutes Act 1964 established four research

institutes: CRIN, NIFOR, ARIN and NITA⁽¹⁾.

The Agricultural Research Council of Nigeria Decree 1971 vested responsibility for coordinating all agricultural research in the Council. The Agricultural Research Institutes Decree 1973 empowered the Federal Commissioner for Agriculture and Rural Development to establish institutes to conduct research and training in any field of agriculture, veterinary sciences, fisheries, forestry, agro-meteorology and water resources and to take over any existing state research station. This was a major development because the 1963 Constitution had placed "scientific and technological research" on the concurrent list, meaning that regional/state as well as the federal government could engage in agricultural research. What appeared to be the modus operandi of agricultural research after the 1954 Constitutional change was that federal departments would handle basic research while the regional departments would conduct applied research.⁽²⁾ In one fell swoop, the 1973 decree destroyed the foundations being laid for a cooperative federal-state agricultural research system. One notable consequence is that no State Government has, since 1973, established any agricultural research facility either for fear of arbitrary seizure by federal authorities or because the decree provided a ready excuse for States to abdicate their responsibility, especially now that State Governments no longer have the powers to tax farm produce. This abrupt termination of a cooperative federal-State agricultural

(1) See Table 4 for full meanings.

(2) The International Bank for Reconstruction and Development recommended in its influential 1955 Report on Nigeria "that all basic research on livestock, crops, fisheries and forests should be done by the federal government while the regions should concentrate on applied research or the experimental application of research findings". International Bank for Reconstruction and Development, The Economic Development of Nigeria, The Johns Hopkins University Press, 1955.

research system also meant that a cooperative federal-State agricultural extension could not develop. The failure to integrate agricultural research and extension remains a major handicap of the national agricultural research system.

By the Research Institutes (Establishment) Order 1975, fourteen research institutes were created: three under food crops (NCRI, NRCRI, NIHORT); four in tree crops (CRIN, ARIN, NIFOR and FRIN); four in veterinary and livestock (NVRI, NAPRI, NITA and LRIN) and three in fisheries (LCRI, KLRI and NIQMA). Of the fourteen, four had been created by the Research Institutes Act, 1964 (CRIN, NIFOR, NITA and ARIN); four were converted from Federal Research Departments to full-fledged research institutes (NCRI, NRCRI, FRIN and NVRI); three were converted from research units of federal departments into full-fledged research institutes (LRIN, LCRI and NIQMA) and in one instance, a research arm of a University was converted to a research institute (NAPRI).

The National Science and Technology Development Agency Decree, 1977 repealed the 1973 decree and set up an executive agency to coordinate all research in Nigeria, agricultural and nonagricultural. The National Science and Technology Development Agency (NSTDA) was to advise the federal government on national science policies and priorities, prepare plans for the development of science and technology and prepare annual budgets for scientific research and receive grants for allocation to research institutions. It was also to advise the government on the creation of new research institutes and centres and the reorganization of existing ones as well as allocate special research projects to the Universities. The agency was to facilitate the application of research results and advise on scientific and technical manpower requirements. The decree also empowered the NSTDA Commissioner to take control of any existing federal or State research establishment, thus confirming the

Table 4: The Distribution of Agricultural Research Institutes,
Nigeria, 1984.

<u>Institute</u>	<u>Research Emphasis</u>	<u>Headquarters Location (State)</u>
1. Institute for Agricultural Research (IAR)	Sorghum, Millet, Wheat barley	Samaru (Kaduna)
2. National Cereals Research Institute (NCRI)	Rice, Maize, Grain Legumes Sugarcane	Ibadan (Oyo)
3. National Root Crops Research Institute (NRCRI)	Yams, Cassava, Cocoyams and Potatoes	Umudike (Imo)
4. Institute of Agricultural Research and Training (IAR&T)	Cereals and Legumes	Ibadan (Oyo)
5. National Institute for Horticultural Research (NIHORT)	Fruit and Vegetables	Idi-Ishin - Ibadan (Oyo)
6. Cocoa Research Institute of Nigeria (CRIN)	Cocoa, Kola, Coffee and Cashews	Gambari-Ibadan (Oyo)
7. Rubber Research Institute of Nigeria (RRIN)	Rubber	Iyanomo (Bendel)
8. Forestry Research Institute of Nigeria (FRIN)	Forests, Wild flora and fauna	Ibadan (Oyo)
9. Nigeria Institute for Oil Palm Research (NIFOR)	Oil palm, Vaphia, Coconut, dates	Near Benin City (Bendel)
10. Kainji Lake Research Institute (KLRI)	Fish and Irrigated Crops	New Bussa (Kwara)
11. Lake Chad Research Institute (LCRI)	Fish	Maiduguri (Borno)
12. National Institute for Oceanography and Marine Research (NIOMR)	Fish	Lagos
13. National Animal Production Research Institute (NAPRI)	Livestock	Shika-Samaru (Kaduna)
14. Nigerian Institute for Trypanosomiasis Research (NITR)	Trypanosomiasis and Onchocasiasis	Kaduna (Kaduna)
15. National Veterinary Research Institute (NVRI)	Cattle	Vom (Plateau)
16. Leather Res. Inst. of Nigeria (LRIN)	Leather	Zaria (Plateau)
17. Agricultural Extension Res. Liaison Service (AERLS)	Extension Services	Samaru - Zaria (Kaduna)
18. Nigerian Stored Products Res. Inst. (NSPRI)	Storage of Food & export Crops.	Lagos

provisions of the 1973 decree which assigned a lame-duck role to the States in the establishment of research institutes.⁽¹⁾ By the decree, all research institutes established under the 1975 decree were brought under the aegis of the NSTDA. The Research Institutes (Establishment) Order, 1977 established the Nigerian Stored Products Research Institute to conduct research into bulk storage of export products as well as locally consumed foodstuffs.

The 1979 Constitution (now suspended by the military) placed "industrial and agricultural research" on the concurrent list meaning that agricultural research could be jointly conducted by both federal and State governments. The ousted civilian administration scrapped the NSTDA and replaced it with a full Ministry of Science and Technology Ministry. The new military administration has scrapped the Ministry of Science and Technology and merged it with the Ministry of Education.

Observation on the Development of Nigeria's National Agricultural Research System

The evolution of Nigeria's agricultural research system conforms with Ruttan's classification of the origins of research institutes.⁽²⁾

First were the research institutes created to cater largely for the needs of export crops (palm oil and palm kernels, cotton, groundnuts, rubber, cocoa, et al). Second were the research institutions that grew out of the research units of Ministries of Agriculture at Moor Plantation, Umudike, Shika, et al. Third were the pan-territorial research institutes that were to cater for export commodities in broad ecological regions in Anglo-phone

(1) Report of Research Institute Review Panel, 1980/81 Ibadan:
(Green Revolution National Committee, 1981).

(2) See V.W. Ruttan, Agricultural Research Policy (Minneapolis:
University of Minnesota Press, 1982).

West Africa. Had the West African Research Organization not been destroyed by the nationalist euphoria that accompanied independence in the 1960s, perhaps the story of the Consultative Group on International Agricultural Research would have been told differently today. Also, the national research systems in Anglophone West Africa would have developed in different directions from what we now know.

Fourth, the adoption of a federal constitution (1954) marked the beginning of the development of a cooperative federal-state agricultural research system with the creation of research institutes from the federal departments of agriculture and the regional Ministries of Agriculture. The Constitution placed "scientific and industrial research" on the concurrent list implying that both federal and State governments could engage in agricultural research. Yet there was an anomaly in that agriculture itself was left as a regional responsibility with the federal government not supposed to play any role.

Fifth, there was no real coordination of agricultural research within the country. The Technical Advisory Committee inaugurated in 1955 could only perform an advisory role and even this appeared to have been a limited exercise within the federal agricultural research establishment.⁽¹⁾

Sixth, the regions saw their role in agricultural research in the applied and experimental application of the results of basic research, which was seen as the proper domain of the federal government.

(1) The Federal Department of Agricultural Research was located in the Federal Ministry of Economic Development, the sole voice for agriculture at the federal level during 1954 - 1965. The Federal Ministry of Natural Resources and Research was established in 1965 to coordinate federal programmes at the federal level - "agriculture" was deliberately omitted from the title of the new Ministry in order not to hurt the political sensibilities of the regions.

Seventh, unlike the development of the decentralized cooperative system in the United States, the research institutions did not develop in response to local, state and national movements and pressure groups. The decentralized system in Nigeria developed largely to cater for the regional export economies prompted by the needs of imperial transnationals and nurtured by a colonial civil service. The achievements of research institutions have hardly ever become political issues in Nigeria the same way that they become campaign issues in State elections in the United States in the 1880s and 1890s.⁽¹⁾ Thus, research institutes in Nigeria have not developed a tradition for quick flexible responses to farmers' needs.

Finally, the Nigerian agricultural system has been a beneficiary as well as a victim of the oil boom. The creation of new institutes and the dramatic increase in resource allocations in the last decade was made possible by the petroleum revenue windfall. However, it also created a "fiscal superman" syndrome at the federal level resulting in the federal take-over of all State-owned agricultural research institutes in 1975. This destruction of a decentralized cooperative joint federal-State agricultural research system remains a major handicap of the national agricultural research system till this day.

Stages of Agricultural Development and the Evolution of a National
Agricultural Research System.

The growth of the national agricultural research system closely reflects the stages of agricultural development. In Nigeria, four phases

(1) See W.L. Peterson and J.C. Fitzharris, "Organization and Productivity of the Federal-State Research System in the United States" in Resource Allocation and Productivity in National and International Agricultural Research, T.M. Arndt, D.G. Dalrymple and V.W. Ruttan (Eds.) (Minneapolis: University of Minnesota Press, 1977).

can be identified.

Stage 1: The Low Level Equilibrium (Pre-Colonial) Era

The agricultural economy was characterized by low level equilibrium, with food supplies and demands equilibrating at prices most people could afford. On the supply side, farm inputs were mostly rudimentary, with production processes perfected over generations through a trial and error process. The more progressive farmers blazed the technological trail but there was no organized research. Extensive agriculture prevailed, in Ruttan's frontier model,⁽¹⁾ with shifting cultivation being extensively practised in its original form.

Stage 2: The Golden Age of Commodity Exports

In Nigeria, this dates back to the turn of the century with the development of the regional export economies in cocoa, groundnuts, cotton and oil palm. Initially, the source of growth comprised mainly of extending the frontiers of cultivation as new export production activities were added to traditional food production through expansion in cropped hectareage. Subsequently, production research and maintenance research was necessary to select varieties suited to particular ecological zones and to prevent losses. Yields per man and per hectare however remained low.

Research institutes were established to produce new knowledge and technology for the new export crops. Export crops were subject to a variety of taxes, some of which were used by the State governments to fund the research institutes. Research resource allocations were heavily biased in favour of export crops. This stage was also marked by major social programs in education, health and public utilities, with a definite urban bias. Though dramatic production increases in export crops were recorded in the first five decades of this century, growth rates had begun to taper

(1) V.W. Ruttan, Agricultural Research Policy.....op cit.

off dramatically in the decade of African independence from colonial rule, the 1960s.

State 3: The Post Colonial Stagnation Era

Urban minimum wage laws, gross rural-urban imbalances in per capita supplies of basic amenities, the cumulative effect of heavy taxation of agriculture, et al all began to take their toll on Nigerian agriculture in the 1960s - resulting in massive rural-urban migration. New pressures were exerted on the agricultural system to produce and market more food to feed the rapidly increasing urban masses.

The sudden realization of the need to dramatically expand domestic food production led to crash programmes aimed at raising productivity - land development schemes, tractorization schemes and heavy reliance on borrowed technology, among others.

Stage 4: The Age of Food Crisis

This stage in the development of agricultural economies of developing African countries is characterized by declining per capita production of food and fibre, drastic fall in traditional export crops, soaring domestic food prices and food imports, et al.

The sudden realization of the need to dramatically expand domestic agricultural research capacity to generate new knowledge and technology on food crops created internal pressures which led to the creation of new research institutes devoted solely to food commodity research or to a rationalization of the existing system to give selected research institutes specific food commodity research focus. Resource allocations to food research have also been dramatically increased. There have been crash programme to raise productivity per farmer (land development schemes, subsidies on farm machinery) as well as productivity per hectare (massive fertilizer and pesticide imports and subsidies and the development of a national seed service, among others).

This view of national agricultural research within the context of the agricultural and macro-economy suggests that rather than concentrate on the traditional supply-side approach, we should spend more research time on the demand side (more on this shortly). We could correspondingly identify four stages of growth of national agricultural research systems in Nigeria and much of Africa: the trial and error experimentation (pre-colonial) low level equilibrium era, the age of commodity export crop research, the post-colonial stagnation era and the food commodity research era.

The inability of the national agricultural research system to spearhead the structural transformation of the Nigerian agricultural economy suggests a need to identify the critical issues involved in developing an effective system.

III. KEY ISSUES IN NIGERIA'S AGRICULTURAL RESEARCH POLICY

1. The meaning of a National Agricultural Research Policy

Nigeria did not have an explicit or coherent national agricultural research policy for most of her history. Any policy as such could only be implied and it consisted of ad hoc creations of research facilities that were largely the product of history and the perceived needs of the moment. What could be the main elements of a national agricultural research policy within a developmental context?

Objectives of Agricultural Research Policy. A clear statement of objectives is required to rationalize research resource allocations and to ensure consistency with the objectives of the agricultural sector, the macroeconomy, society's goals, values and aspirations as well as the nation's factor endowments. Within the African context, such objectives include (i) creation of new knowledge and technologies in the form of new production processes, new inputs and new outputs (ii) liberalizing access to new high pay-off inputs through the introduction of new technologies and inputs that are largely scale-neutral (iii) substituting abundant and cheap resources for scarce

and expensive inputs (iv) reducing food and agricultural production costs (v) raising farmers' income, and (vi) making the agricultural sector more responsive to price and other policy incentives by increasing its dependence on productive inputs which are more supply price elastic. Some or all of these objectives could be translated into quantitative targets in a national plan for agricultural research.

Agricultural Research Policy Instruments. These include creation of research institutes together with statutory allocation of commodity/input research responsibilities, and the location of research institutes and institutions to manage the national agricultural research system. Other policy instruments include relative research resource allocations, wages and service conditions of research staff, training facilities to build up the institutional and intellectual capital of research institutes, and subsidies on inputs created from new knowledge and technology from the research system. Other complementary policy instruments include tariff policy on research materials and other imports, farm credit, support for output and input markets and resource allocations to rural infrastructures. Farm input subsidies are also an important policy instrument though they also serve some other macro policy objectives.⁽¹⁾

Policy must then be implemented, monitored and evaluated, the latter requiring prior specification of performance indicators and measures.

(1) For a full discussion of the role of farm input subsidies, see Idachaba, F.S. Farm Input Subsidies in Nigeria's Green Revolution Programme: Lessons from Experience, Food Policy Research Paper 2, Department of Agricultural Economics, University of Ibadan, 1981; Idachaba, F. S. (1974) "Policy Distortions, Subsidies and African Rural Employment Creation: A Second-best Approach," Indian Journal of Agricultural Economics, Vol.XXIX, No.2, pp. 20-32.

Agricultural Research Policy Impact

On policy impact, the allocative consequences of agricultural research policy are fairly relatively easier to handle - especially the effects of new technologies on relative scarcities and prices. The distributional consequences have been harder to measure, though they are no less important.

Two observations are pertinent. Firstly, agricultural research policy objectives are derived from agricultural sector objectives, which are derived from overall macro-economic objectives. Macroeconomic objectives are, derived from overall societal goals, objectives and aspirations which are conditioned by the domestic and international environments. This way of viewing policy objectives through a set of transformation functions ensures consistency between "lower level" objectives (e. g. agricultural research) and "higher level" objectives (e. g. agricultural sector). It also ensures that changes in higher level objectives are sequentially transmitted to lower level objectives. For example, a new policy objective to become self-sufficient in main food staples could get translated into new research objectives to breed and disseminate high-yielding varieties of those food commodities of which the country is a net importer.

Secondly, agricultural research policy has concentrated on the supply-side (top - bottom) to the neglect of the demand-side (bottom - up). This has had several defects for the agricultural policy process in much of Africa, some fatal. Policy objectives have been articulated largely by bureaucrats with farmers and farmers' organizations playing no role. Policy instruments were identified and utilized by bureaucrats with little or no consultation with farmers and farmers' organizations. Consequently, the end users of research output have been unable to monitor research work

and to articulate their needs. Thus there is a long time lag between the emergence of a problem and the widespread adoption of a research solution.

Unless the national agricultural system operates within a general policy frame, programs and projects would tend to be characterized by institutional and other policy ad hocery with frequent policy revisions, modifications and, quite often, complete policy reversals. The absence of an explicitly articulated agricultural research policy statement largely explains the erratic mode in which agricultural research has evolved in Nigeria and other African countries over the years.

2. Resource Allocation Priorities

The following criteria could be identified for allocating resources to agricultural research, among commodities, inputs and over time.⁽¹⁾

(1) Foreign Exchange Contribution of Commodity:

The working rule is: for a given budget for foreign exchange savers/earners, allocate research resources to a commodity in direct proportion to its relative importance as a foreign exchange earner/saver. But this leaves unanswered the question of the relative resource allocations

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- (1) Note that allocative criteria are essentially country specific, reflecting a country's peculiar constraints and opportunities and are therefore not necessarily applicable to other countries. Also, allocative criteria are essentially dynamic, reflecting changes over time in a society's goals, opportunities and constraints.

The literature on allocative criteria for agricultural research is extensive. For a small sample, see W.L. Fishel (Ed.) Resource Allocation in Agricultural Research (Minneapolis: University of Minnesota Press, 1971); T.M. Arndt, D.S. Dalrymple and V.W. Ruttan (Eds.), Resource Allocation and Productivity in National and International Agricultural Research (Minneapolis: University of Minnesota Press, 1977; D. Daniels and B. Nestel (Eds.) Resource Allocation to Agricultural Research (Ottawa: International Development Research Centre, IDRC 182e, 1981) and V.W. Ruttan Agricultural Research Policy (Minneapolis: University of Minnesota Press, 1982). For specific Nigerian case studies, see F. S. Idachaba, Agricultural Research Policy in Nigeria (Washington D.C.: International Food Policy Research Institute, Report No. 17, 1980); F.S. Idachaba, "Agricultural Research Resource Allocation Priorities: The Nigerian Experience" in Resource Allocation to Agricultural Research, D. Daniels and J. Nestel (Eds.) op.cit.

to domestically traded goods as a class and internationally traded goods as a class. The colonial phase witnessed a very skew allocation process in favour of export crops, almost to the neglect of food crops both in aggregate allocations as well as in micro-resource allocations at the research institute level (see Tables 5 and 6). Relevant weights for allocation to export crop research in this working rule are the share of agricultural exports in total export earnings and the share of agriculture in GDP.

(ii) Fiscal Role of Crop:

The real world in many African countries is filled with policy-induced distortions in the form of marketing board taxes that have become institutional realities. To this extent, these countries face a second-best problem of constrained optimization so as not to kill the goose that lays the golden egg. A working rule is: allocate research resources to crops in direct proportion to their relative importance in government revenues. The objective is to expand the production and revenue base of the crop.⁽¹⁾ Long after the adverse consequences of marketing board taxation had been demonstrated, Nigeria's macroplanners were still assigning a major fiscal role to them in the Second National Development Plan.

(1) In Nigeria, 7.5% of operating revenue of produce marketing boards was statutorily to be expended on research. Grants by the Regional Marketing Boards during 1955 - 61 were: Western Nigeria - ₦10 million mainly for cocoa research and extension; Northern Region - ₦5.6 million, mainly to Samaru Research Station with ₦3.2 million for general research and ₦2.4 million specifically for cotton development. The World Bank had earlier recommended that the recurrent costs of the West African Institute for Oil Palm Research (WAIFOR) be met from an endowment to which the Nigerian Oil Palm Produce Marketing Board contributed 82%. The Cocoa Marketing Board also provided funds for WAIFOR: in 1953/54 the Cocoa Marketing Board provided ₦474,000 for cocoa and soil survey. In Northern Nigeria, the Marketing Board provided ₦226,000 for cotton development in 1953/54.

(iii) Value of Production:

The working rule here is to allocate resources to commodities in proportion to their share of agricultural GDP.

(iv) Value of Urban Consumption:

Foods with higher per capita urban consumption (relative to rural areas, probably reflecting a higher income demand elasticity differential) tend to command higher research priority. This is because of the high social costs of urban riots and political unrest. Nigeria has launched special programmes to boost rice and dry season wheat production. Yet both rice and wheat are far below sorghum and millet in terms of value of production.

(v) Regional Development:

Large sections of the country should not be left behind in the development process. The implied working rule here is that research resource allocations to crops should be proportional to their relative shares of total cropped area, in order to achieve balanced regional development.

(vi) Employment Generation Potential:

Those African countries with abundant and cheap sources of farm labour supply should allocate research resources to crops that will fully utilize the abundant resource. In Nigeria, labour is expensive and research resources should be allocated to enhance the utilization of the relatively abundant resource-land.

(vii) Politically visible crops:

Social responses in urban areas to shortfalls in supply vary from food item to food item. Among the politically most visible are the convenience foods (bread and garri (processed cassava)), sugar, milk and rice. The more strategic a crop is in terms of political visibility, the higher the research priority that should be accorded it. This may be an

Table 5: Federal Government Allocations to Food Crop, Export Crop and Industrial Crop Research, Second National Development Plan 1970 - 74.

	<u>Allocations</u>	<u>Allocations as Percentage Total Agric. Research</u>	<u>Allocations as Percentage of Federal Govt. Expenditure on Agriculture</u>	<u>All Sectors</u>
	- N mill.			
Research on Food Crops	2.286	33.02	3.71	0.21
Research on Export Crops	4.376	63.20	7.10	0.39
Research on Industrial Crops	0.262	3.78	0.42	0.02
Total Expenditure on All Crop Research	6.924	100.00	11.23	0.62
Total Expenditure on Agriculture (Federal)	61.670	-	100.00	5.55
Total Expenditure on All Sectors (Federal)	1110.138	-	-	100.00

Source: Underlying data from Second National Development Plan 1970-74 (Lagos: Federal Government Printer, 1970).

Table 6: Export Crop Research Dias in Fertilizer Trials in Food and Export Crops Compared with Thier Relative Importance in Hectarage, Northern Nigeria, 1952-61.

<u>Crop</u>	<u>Number of Fertilizer Trials - 1952-61</u>	<u>% of Trials in all Crops</u>	<u>Estimated Annual Hectarage (ha)</u>	<u>% of hectarage all 8 crops</u>	<u>Annual Crop Hectarage Per Trial conducted (ha)</u>
Sorghum	37	13.59	3,109,375	36.63	36,659
Millet	8	1.25	3,240,000	37.22	405,000
Groundnuts	136	29.06	894,321	10.27	4,308
Cotton	23	3.59	477,090	5.48	20,743
Yam	90	14.06	370,980	4.26	4,122
Maize	28	4.38	352,755	4.05	12,598
Rice	59	9.22	133,105	1.59	2,241
Soyabean	46	7.19	47,385	0.54	1,030
All Export Crops	300	46.80	1,410,796	16.30	4,700
Food Crops	340	53.12	7,237,215	63.70	21,433
All Crops	640	100.00	8,706,011	100.00	13,603

Source: Idachaba, F. S. Agricultural Research Policy in Nigeria, (Washington, DC: International Food Policy Research Institute, Research Report No. 17, 1980).

act of self-preservation on the part of the ruling political class but it may also mark the beginning of endogenous technical change.

(viii) Nutritional Significance of Crop:

The higher the nutritional significance of a food item or class of foodstuffs as a source of calories or protein, the higher the research priority that should be accorded it, using a given base period.

(ix) Value Added and Import Substitution:

Research resources could be allocated in direct proportion to the share of the crop in domestic value added and also in proportion to the contribution in raw materials for important-substitution.

(x) Narrowing Wealth and Income Inequality:

Research resource allocation should accord relatively high priority to those commodities the production of which narrows existing wealth and income inequalities. This suggests research priority for new inputs that are within the economic reach of poor farmers; it also suggests research into the wealth and income distribution consequences of new technologies.

(xi) The Foods that the Poor people Eat:

Research priority should be accorded those commodities that poor people eat, especially foods that are relatively income elastic at low income levels. This will uplift the welfare of the poor.

(xii) Self-Reliance Strategies:

Research resources could be allocated in direct proportion to food import dependency, meaning that research priority be accorded those commodities in which a country has high food import dependency ratios. In Nigeria, wheat, sugar, maize and rice are obvious candidates for priority attention.

Conflicts in Allocative Criteria: How to resolve conflicts in allocative criteria remains an unresolved issue - especially when conflicts arise from limited supplies of scarce resources. One possible solution is to

streamline the transformation relations between "lower level" objectives/priorities and "higher level" objectives/priorities so that the latter would implicitly assign weights to the former.

We conclude this section with a brief mention of research resource allocation priorities in extension and training. In extension, priorities need to be established with respect to extension messages (content), and extension production process. As with research per se, research into extension will produce new extension knowledge and technology; extension priorities are indirectly derived from the research priorities.

Training priorities are determined by the imbalance between research personnel needs and research personnel capabilities in those research activities with the highest potential social pay-off. Such needs are also related to the cycles of growth of research institutes, that is, the shifting focus on production, maintenance and product utilization research.

In extension, training priorities are determined by the imbalances between extension personnel needs and extension personnel capabilities. Finally, training capabilities need to be developed with priorities being determined by the needs of people to be trained for research and extension and the system's capacity to undertake the required training.

3. The Integration of Research, Extension and Training

The historical circumstances of the evolution of Nigeria's agricultural research system have almost guaranteed the lack of integration of research, extension and training. Initially, there were the departments of agriculture for the northern and southern provinces. The federal constitution (1964) and the regionalization of agriculture gave birth to three regional departments and their relevant research arms, in addition to the research institutes created by the Research Institutes Act 1964. Since agriculture became a regional responsibility - and by implication extension - the federal government ended up with an impressive list of research institutes but was constitutionally

barred from any agricultural extension activities. By 1975, the federal government had taken over all agricultural research institutes as seen earlier but no provisions were made for liaison with State extension services. The system has ended up with the worst of both worlds: it has neither the unique features of a Rothamsted Experiment Station nor the integrated system of the United States Grant College. While the Morrill Land Grant College Act (1862) and the Hatch Experiment Station Act (1887) provided the basis America's decentralized cooperative federal-State agricultural research system,⁽¹⁾ Nigeria's Agricultural Research Institutes Decree (1972) and the National Science and Technology Development Agency Decree (1977) guaranteed that Nigeria shall have one monolithic (federal) agricultural research system that remains unviable and unworkable in a heterogeneous federal set up.

With one or two exceptions, Nigeria's agricultural research institutions remain in total isolation from the Universities - situation that stands in great contrast to the historical evolution of the United States system where the State College of Agriculture formed the base while the agricultural experiment station, attached to the college, conducted research.⁽²⁾

(1) See W.L. Peterson and J.C. Fitzharris, "Organization and Productivity of the Federal-State Research System in the United States" in Resource Allocation and Productivity in National and International Agricultural Research, T.M. Arndt, D.G. Dalrymple and V.W. Ruttan (Eds.) (Minneapolis: University of Minnesota Press, 1977).

(2) See W.L. Peterson and J.C. Fitzharris, "Organization.....
....."op cit (Minneapolis: University of Minnesota Press, 1977).

4. Institutional Responsibility for Agricultural Research, Extension and Training

It is presumed that the political leadership in a State within a federal set up does not allocate scarce resources to agricultural research as if it did not care whether residents in the State are in a position to reap the full benefits therefrom. That is, State decision makers are indeed worried about the "free rider" problem, about the benefits of research which "spill over" to residents of other States at no cost to them. Yet, transactions costs of exclusion of free riders appear prohibitive. The result is that there would be under-investment in basic research - whose benefits are generally freely appropriatable - if it were left solely to State governments⁽¹⁾ (see Figure 1). This suggests that the federal government handle mainly basic research while State governments concentrate on applied and adaptive research, while local governments should concentrate on local field trials to suit particular environmental niches.

National Research Institutions and International Research Centres:

The CGIAR Centres see their role primarily in the applied research area because of constraints imposed on them by their sponsors to show practical research results of regional and world-wide relevance. Research institutions in the developed countries feel they have the capability for basic research that ought not to be duplicated by the CGIAR Centres or the national institutions. But this leaves two unanswered questions: one, who does basic research into problems that are specific to the tropical environment and two, what is the research portfolio of a mature CGIAR Centre?⁽²⁾ The complementarities between national systems and CGIAR Centres also centre around the sequencing of research activities: how do they share the sequencing

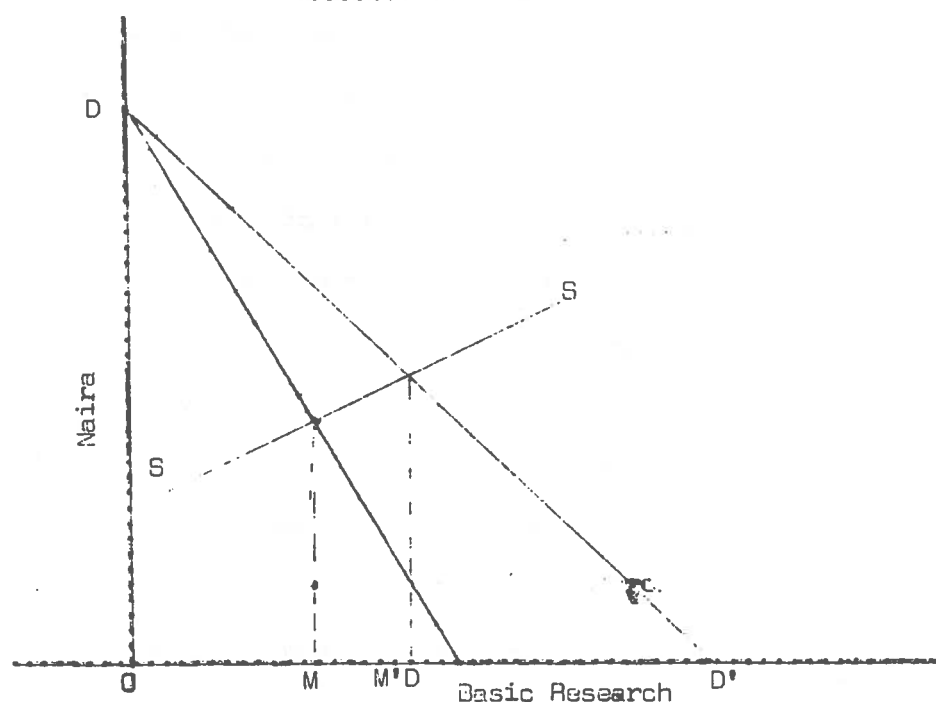
(1) For more details, see Idachaba, F.S. Agricultural Research Policy in Nigeria (Washington D.C.: International Food Policy Research Institute, Research Report 17, 1980).

(2) For more discussion of this, see V.W. Ruttan, Agricultural Research Policy (Minneapolis: University of Minnesota Press, 1982).

between production, maintenance and processing research?

Extension services are best rendered through a decentralized system because of their location specificity - implying that this is the primary responsibility of State and local governments. However, extension knowledge and technology that have general applicability across ecological zones and social systems should attract federal resources. More or less the same arguments apply to training.

Figure:1 Demand and Supply of Basic Research



Note: Curve DD is the demand for basic agricultural research by the residents of one State. Curve DD' is the demand for basic agricultural research by all Nigerians. Curve SS is the supply of basic agricultural research. OM is the optimum amount of basic agricultural research for one State. OM' is the optimum amount of basic agricultural research for Nigeria.

Public and Private Sector Involvement in Agricultural Research:

The initial development of research capabilities in Nigeria owes a lot to the imperial multinationals as seen above. They funded and stationed research teams especially in cotton research at Samaru, concerned mainly with maintenance, and later, production research to select and breed varieties that were suited to the agro-climatological conditions of the northern savannah belt. This active private sector involvement ended in the 1960s and local agencies of multinationals continue to shirk their responsibility in this area. With the exit of the British Empire Cotton Growing Corporation, the cessation of cotton exports and the establishment of the Nigerian Cotton Board (a public parastatal), no new grounds have been broken with respect to joint public-private sector participation in agricultural research. Are there incentives for domestic private sector firms to engage in concerted meaningful agricultural research, beyond quality control and formulation activities? If not, what incentives would they require? Initially, the small and fragmented farm input markets and the "free rider" problem are dis-incentives for private sector participation and government encouragement is required. There is however a structural disincentive. In the colonial system when overall economic policy including tariffs, subsidies, among others, were in colonial hands, it was easier and considered "safer" by multinationals to engage in substantial agricultural research. With independence and the change of guards at the helm of economic affairs, multinationals and their local agencies have been unwilling to invest in desired research activities. They have relinquished all research responsibilities to nationalist governments which have however not been forthcoming in the required research support. How much are transnationals prepared to invest in a developing country's future?

5. Funding of Research, Extension and Training

Funding of agricultural research in Nigeria has moved from the cooperative joint federal and State government-private sector funding of the colonial system to the present monolithic system in which the federal government funds all research. As mentioned above, the present system, dating back to 1975, is unviable and is insensitive and unresponsive to the pressing research problems of local economies within the country.

Table 7 shows recent trends in the funding of agricultural research in Nigeria. Two observations are pertinent. First, funds actually released were, almost always, less than budgeted sums. Second, relative allocations in recent years reflect little about the research purpose - rather budgeted sums were in most cases amounts required just to pay overheads such as salaries and wages, etc. Thus the older research institutes with larger overheads tend, on the average, to have larger budget allocations but not necessarily any more research activity.

Funding of research has not only been inadequate, it has been unstable. Uncontrollable and undesirable fluctuations in research funding result in half-hearted research programming, uncompleted projects and abandoned projects. It is difficult for researchers to have a long time horizon under these circumstances. Annual reports of research institutes contain long lists of projects that are "rolled-on" from one year to the next for lack of funds or for unstable funding. Closely related to this is the untimeliness of release of funds which introduces so much uncertainty into research programming as to reduce its overall effectiveness.⁽¹⁾

(1) During 1975-80, funds released to the research institutes as a percentage of budgeted sums ranged from 25 - 50 percent, See Report of Research Institutes Review Panel, 1980/81, Green Revolution Nation Committee, Vol.2, p.20.

Table 7::: Federal Government Recent Resource Allocations to Research Institute, 1970/71-1974/75, of \$1.00

[illegible]

Funds have, on the average, been provided along disciplinary/divisional lines rather than along programmatic lines. The programme performance budgeting system is just being introduced in some institutes. Actual expenditures end up not being related to commodity priorities.

State governments and the private sector must take decisive steps to provide funds for applied and adaptive agricultural research into farm production and input problems. New legislation is urgently required to provide and protect State government and private sector investments in agricultural research.

Finally, there is the issue of the extent to which actual expenditures at the institute level reflect set down programme priorities at the institute or national level. This borders on research management to which we now turn.

6. Research Management

Research management probably constitutes the most important constraint on Nigeria's national agricultural research system. The management problem is at two levels: macro and micro. The macro level refers to the management of all the agricultural research institutes by national institutions (ministries, parastatals, office of the President, etc.). The institutional modalities for managing the nation's agricultural research system have been in a state of flux, beginning with the Nigerian Research Institutes Act (1964) but more so since the Nigerian Council for Science and Technology Decree (1970) and the Agricultural Research Council of Nigeria Decree (1974). Frequent changes in institutional arrangements have left the national agricultural research system with no consistent and clear sense of direction (see Table 8). In the process, no durable overall plan for agricultural

Table 8: Federal Parastatals in Agriculture as at 1983

<u>Type of Federal Parastatal in Agriculture</u>	<u>No. of Parastatals in 1983</u>
<u>Parastatals Involved in Direct Production and Distribution</u>	
1. Commodity Boards	6
2. Companies Involved in Direct Agricultural Production ...	11
3. River Basin Development Authorities	11
<u>Parastatals Not Involved in Direct Production.</u>	
4. Agricultural Credit and Input Supplies	4
5. Agricultural Research Institutes	13
6. Agricultural Development Projects ⁺ (ADPs)	21 ⁺
7. Miscellaneous	8

+ 13 ADPs had taken off; the remaining 8 were preparatory allocations.

research has emerged. (1) Many institutes have had directors appointed on grounds other than professional merit and demonstrated potential for providing research leadership. This has had disastrous consequences for morale within the institute research community.

Closely related to the macromanagement problem is the problem of inadequate appreciation of the intrinsic value of research by policy makers outside the agricultural establishment and by the society at large - especially the discipline and commitment to fund research with no immediate value. This has given rise to grossly inadequate and unstable funding and excessive delays in the release of funds.

Research institutes have not been subject to regular research management audit that evaluates the institute's capabilities to achieve research objectives and targets. In particular, no system exists for forecasting future research priorities or for regularly ensuring that existing national priorities are closely adhered to in research programming - at the institute level. Closely related to this is the problem of priority distortions during period of budget squeeze. Rarely do research directors in response to severe budget squeeze close down whole programs, units or sections in the face of new realities and revealed national priorities. (2)

(1) Almost a century after the launching of scientific research, the nation is still being promised a comprehensive policy on science and technology: "The following are some of the policies that would be pursued during the Fourth Plan period.

(1) Development of a Comprehensive Policy on Science and Technology. Such a policy will facilitate the transformation of the Nigerian Society into one in which science and technology will form a fundamental part of the thinking apparatus of the average citizen
 "Fourth National Development Plan 1981 - 85 (Lagos: Federal Ministry of National Planning, 1981), Vol. 1, p. 200.

(2) This is the normal approach of a private concern whose existence is threatened by falling profits or mounting debts; mass reorganization is effected, heads roll and new objectives and targets are set. How much of this "survival strategy" can research institutes, or any public institution, for that matter, adopt?

Management at the micro (institute) level poses equally formidable problems. Some directors quickly abdicate their responsibility to provide required research leadership and to motivate young researchers. Others have allowed the proliferation of sections and units especially those developed to satisfy the aspirations of particular individuals.

The national research leadership has failed to develop a reward system that is tied around some measure of researchers' productivity. Consequently professional advancement has been linearly tied up to length of service, like his counterpart in the regular civil service. This has created a sort of identity crisis for the civil servant scientist as succinctly noted by Davies.⁽¹⁾

Unless institute research leadership can manage available physical and human resources to effectively produce new knowledge and technology, the substantial resources being allocated to the national agricultural research system would be wasted.

(1) Notes: David Davies in recounting the British experience from which the Nigerian system largely derives: "The lot of the civil servant scientists seems at first sight to be a much happier one than that of his colleague in industry or a university. Shielded from the short-term pressure to be productive and from the constant questioning and irreverence of the young, the civil servant can pursue a linear career in which he gains seniority as he gains experience. But does the immense stability of civil service science act as a positive hindrance to using scientists' skills in the most effective way? Many would argue that the duties of the civil servant scientist are so different from those of other scientists that it is foolish to apply similar sorts of yardstick except in salary.....much of the scientific work is routine, and a large proportion of employees are engaged in routine laboratory and field work and neither have the qualifications for more, nor would seek broad horizons. But the sort of work called for in the name of research is likely to be every bit as demanding as industrial or university research and the problems to be solved generally much greater, either because they are more complex and involve lots of people or because there is some element of a race, military or civil". In Nature, May 22, 1975 (London), quoted in Research, Education and Extension (New Delhi: Ministry of Agriculture and Irrigation, 1976), Report of the National Commission on Agriculture, Part XI, pp.89 - 90.

The problem of institutional obsolescence at the macro level affects research institute performance as the research leadership receives conflicting signals from successive managers at the headquarters level. Frequent changes in policy directives not only result in half-completed and poorly executed research projects but also disrupts long term research programming.

Organizationally, all the evidence is not on the best mode: whether along disciplinary lines or along programme lines. Some institutes have over-emphasized the disciplinary set up almost to the neglect of meaningful programmatic content while others have emphasized programmes with little or no disciplinary core to back them up.

7. Locations of Research Facilities

The historical error in locating the precursor to the National Cereals Research Institute at Ibadan on the mistaken belief that Ibadan would be suitable for cotton production graphically illustrates the need for more work on modelling optimal locations of agricultural research institutes. In a earlier effort, I found six out of fourteen agricultural research institutes not suitably located for their commodities of research (see Table 10).

On the supply side, an institute should be located where there is a good research environment in order to exploit complementarities in research personnel, materials, good library facilities and equipment. Thus expensive laboratory equipment can be shared, consultations held on research methodology within a large scientific community, et al. Such complementarities are more significant in the early stages of growth of a research institute when it is primarily engaged in maintenance and production research to select and breed varieties suited to the ecological region. Thus, the existence of a university and other research institutes serves to attract other research institutes. This is particularly the case for "discipline-based" research institutes as opposed to commodity-based research institutes. In

Table 9: Suitability of Agricultural Research Institutes Headquarters by Crop, 1968/69 to 1974/75.

Institute	Nearest Three States to Headquarters	Crop	Index Location of Suitability
			(percent)
IAR	Kaduna, Kano, Sokoto	Groundnuts Sorghum Millet Melons Benniseed	65.30 55.14 50.29 7.35 15.65
NCRI	Oyo, Ondo, Ogun	Maize Rice Beans Soyabeans Sugarcane	40.75 35.10 3.95 0.00
NRCRI	Imo, Anambra, Cross River	Yams Cassava Cocoyams	22.90 29.49 65.96
NIFOR	Bendel, Ondo, Imo	Palm Kernels (1969-71)	56.40
RAIN	Bendel, Ondo Imo	Rubber
NIHORT	Oyo, Ogun, Ondo.	n.a.
CRIN	Oyo, Ogun Ondo	Cocoa (1963 69-70/71)	90.05
NAPRI ^a	Kaduna, Kano Sokoto	Cattle	n.a.
NVRI ^a	Plateau, Kaduna, Bauchi	Cattle	n.a.
NITR ^a	Kaduna, Niger, Plateau	Cattle	n.a.

Note: The full names of the institutes listed in the table are as follows: Institute for Agricultural Research (IAR), National Cereals Research Institute (NCRI), National Root Crops Research Institute (NRCRI), Nigerian Institute for Oil Palm Research (NIFOR), Rubber Research Institute of Nigeria (RAIN), National Institute for Horticultural Research (NIHORT), Cocoa Research Institute of Nigeria (CRIN), National Animal Production Research Institute (NAPRI), National Veterinary Research Institute (NVRI), and National Institute for Trypanosomiasis Research (NITR).

^aThough indexes of suitability are not available, indications are that the locations of livestock research institutes in Kaduna State are suitable.

Source: Idachaba, F.S. Agric. Research Policy in Nigeria (op. cit)

addition, the institute must be in a place where it can have adequate administrative support.

There must be adequate supplies of physical, social and institutional infrastructures that would provide a conducive environment for scientists to push themselves to the frontiers of innovation and inventive activity.⁽¹⁾ There must be adequate and reliable supplies of electricity, water, postal and telecommunication facilities, as well as laboratory software (laboratory technicians and technologists, instrumentation engineers, etc.). Thus, a research institute would tend to be attracted to a location with reasonably low maintenance and operational costs per scientific man year.

The ease with which land can be acquired for the research needs of an institute is another important determinant of location - areas with low capital costs per scientific man year in land compensation fees would tend to attract research institutes, all other things being equal.

For a private sector research facility, the availability of government (State or federal) subsidies on infrastructural development could encourage particular choices of locations.

The institute must be relevant to the agroecology of the area and there must be a production environment against which to test the new varieties against various stresses (soils, climate, etc.).

On the demand side, an institute should be located in the core producing area which will constitute the demand for new knowledge and new technology. Through a process of inter-generational unorganized experimentation, the core producing area has a selection of varieties adjusted to the environment which forms the point of departure for the new research institutes varietal selection trials in the subecological zones in the core producing area. The core producing area (where the crop is no longer

(1) For a comprehensive discussion, see V.M. Ruttan, Agricultural Research Policy (Minneapolis: University of Minnesota Press, 1982).

now) is also where farmers have attained allocative equilibrium in the Schultizian sense⁽¹⁾ such that substantial incremental production gains can only come from massive infusion of new inputs and management practices generated by the research institute.

A strand of the above argument is that a research institute should be located in a region with scope for maximum potential development of the crop - a place with huge potential demand for the crop. The experience with maize in Nigeria illustrates this point. Maize was traditionally grown in the derived Savannah belt of Southern Nigeria. Beginning in 1974/75, the World Bank-assisted Agricultural Development Projects (ADPs) introduced new varieties of fertilizer - responsive maize into the farming system of the northern projects. The production effects have been dramatic - in fact, the northern ADPs now constitute the major source of surplus maize now feeding the poultry industry concentrated mainly in the south.

Closely related to the core producing area on the demand side is the need to minimize the costs of technology dissemination/diffusion per producer/beneficiary. The further away is the core producing area from the research institute, the higher the dissemination costs.

The ultimate test of any new technology is its adoption by farmers on the basis of proven profitability. Profitability is a summary measure of technical and economic considerations which are determined within the context of specific farm situations of individual farmers and groups of farmers as decision making units. The location of a research institute in the core producing area minimizes the costs of adaptive, operational and on-farm research.

(1) T.W. Schultz, Transforming Traditional Agriculture.

(New Haven, Connecticut: Yale University Press, 1963).

Conflicts in Research Institute Location Criteria

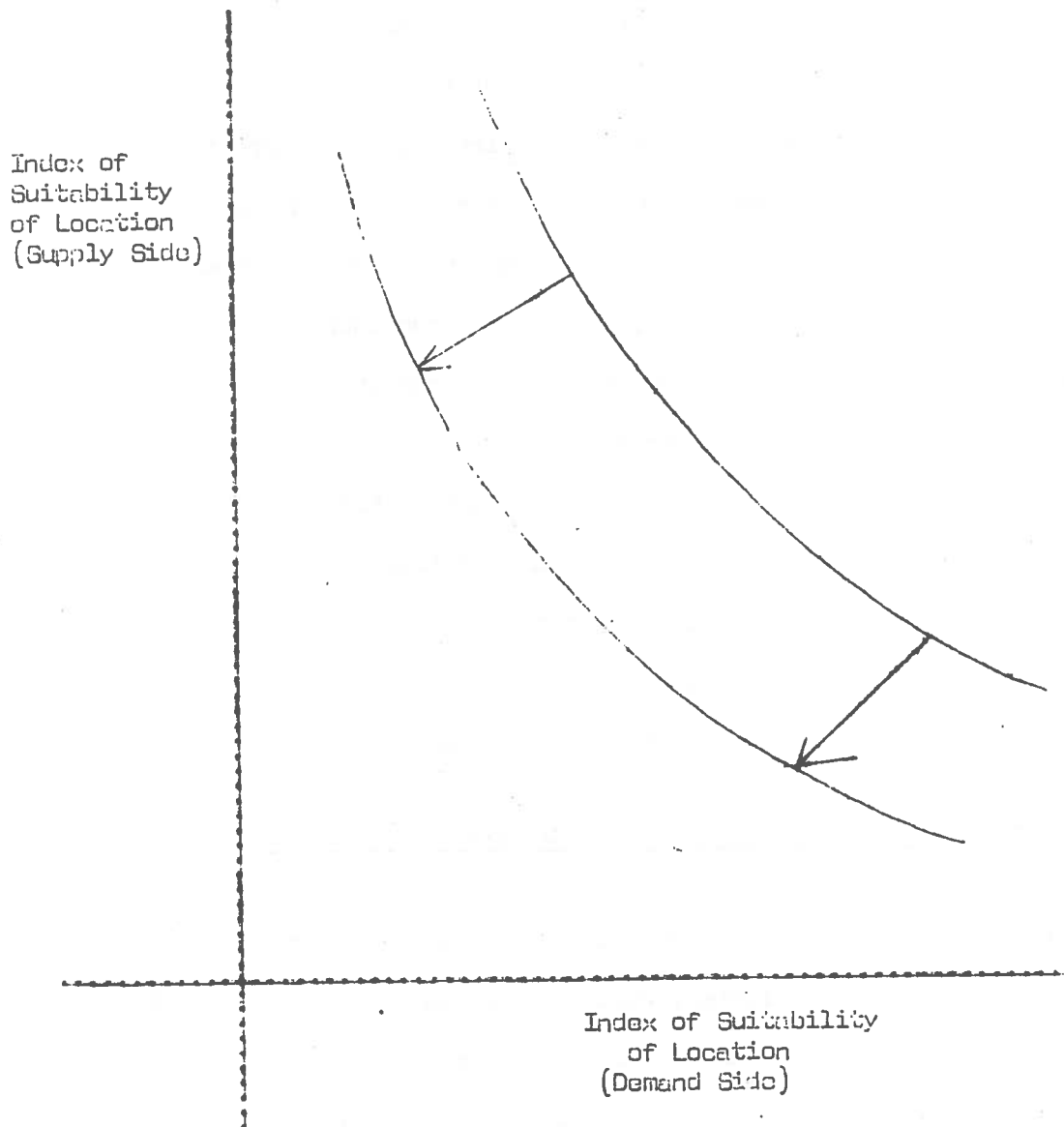
The criteria specified above may conflict. An area may qualify for institute location on demand side considerations because of the concentration of producers, production and demand for new technologies but may fail woefully as a candidate for institute location because, located in some remote part of the country, it has no scientific community, no electricity, water, roads, et al. Under such circumstances there is a conflict, a trade-off between suitability indicators viewed from the supply and demand side (see Figure 2). For example, Badegi in Niger State qualifies as rice research station on demand considerations but fails woefully on supply-side considerations. The result is that such remote research stations are only manned by relatively junior research staff whose potential for inventive activity in scientific research is rather very limited. What is needed is a set of policies that will shift the trade-off curve downwards and to the left. Such policy measures include provision of necessary infrastructures, special allowances and pay incentives for research staff working in such remote areas, etc.

Historical Errors of Location: Guidelines for Constrained Spatial Optimization.

Given that historical errors of location of some research institutes have become institutional realities, what are the guidelines for a second-best optimization? Scrapping such institutes and completely relocating them has never attracted the required political will⁽¹⁾ and courage. 75

(1) For earlier discussion, see F.S. Idachaba, Agricultural Research Policy in Nigeria (Washington D.C.: International Food Policy Research Institute, Research Report 17, 1990; Report of Research Institutes Review Panel (Ibadan: Green Revolution National Committee, 1981), Vols. 1 and 2.

Figure: 2 Trade-Offs between Supply Side and Demand Side Suitability Indicators.



second-best solution is to place a limit on the physical and human resources expansion of the headquarters location of the institute and to decentralize its research activities to the core demand areas of actual and potential production.

In research environments with grossly inadequate infrastructures, economies of scale from initial increasing returns are rapidly exhausted and the internal institute production process quickly encounters diseconomies of scale from diminishing returns as research encounters bottlenecks in the supply of technologists and technicians, electricity and other utility supplies. Under such circumstances and especially for crops spanning different ecological zones, a network of small to medium sized research institute facilities is recommended over large institute facilities.

IV. SUMMARY AND CONCLUSIONS

We have been concerned in this paper with the role of a national agricultural research system in the structural transformation of an agriculture that can no longer expect major output increases from extensive agriculture utilizing present resources or from mere reallocation of traditional factors of production.

In trying to understand why after almost a century of organized agricultural research, there are still no breakthroughs in food production and the food situation appears to be worsening, we examined the origins and the policy environment of the agricultural research system. Though some impressive gains in research were made in cocoa, cotton, groundnut and oil palm research, certain institutional developments almost guaranteed failure. These include, among others: provision for constitutional responsibility for agriculture between State and federal governments, frequent and confusing changes in the institutional arrangements for managing the nation's agricultural research system and the Agricultural Research

Institutes Decree 1973 which, in one fell swoop, destroyed what was left of a cooperative joint federal-State agricultural research system and established a monolithic federal agricultural research system that remains financially unviable, ineffective and unworkable. That a country with ecological and agroclimatological heterogeneity should be operating a research system in which the States contribute virtually nothing to agricultural research is one of the curious legacies of the oil boom of the mid-1970's.

The oil boom created a "fiscal superman" syndrome at the federal level which made the federal government want to do everything! Yet States urgently need a research system which is responsive to the peculiar needs of their respective State economies. In the colonial system, the State agricultural research systems serviced the regional export economies which in turn provided a significant proportion of State revenues from a variety of taxes on marketing board crops.

Nigeria has ended up with neither the Rothamsted model nor the United States land grant system. Even pre-1973 when the States were still active in agricultural research, institutions and facilities were established by policy makers with no grassroots participation on the demand side with the result that there was no clientele monitoring of agricultural research performance.

An examination of some of the key issues in Nigerian agricultural research policy forms the core of the paper. These include the meaning of agricultural research policy within a developmental context, resource allocation priorities, integration of research, extension and training and the allocation of institutional responsibilities for agricultural research. Others include funding, research management and the location of research institutes.