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DECISION-MAKING ON THE AFRICAN FARM

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Introduction

The fundamental nature of decision-making on the African farm is analytically similar to decision-making anywhere. The decision-maker has control over a number of factors or resources which he can define quantitatively and qualitatively more or less precisely according to their nature and the relevant time horizon, and, subject to a series of constraints and influences, he has a range of choices in his use of these factors to achieve several identifiable objectives. To synthesize an African farm would be to identify and value these resources, objectives, constraints and the choice of crops and techniques, it being taken as axiomatic that smallholders make rational decisions and respond to economic incentives. However, too little is known about the competition for farm resources and the nature of farmers' aims and constraints to accurately evaluate the efficiency of their decisions, and the limited aims of this paper are: to examine the nature and interactions of the variables involved, drawing on the insights provided by observations of adjustments to economic pressures recorded in a number of investigations into African farming; and to indicate interesting areas for further research. 1/ But first a note on the decision unit with which we are concerned.

The Decision Unit

The African farm typically combines two interdependent units, the farm-household and the farm-as-a-firm. They share a stock of resources, the allocation of which is the concern of economic decision-making, and the activities and decisions carried out by the household are both affected by and affect the scope for action by the firm. Thus, at the simplest, the household depends on the farm to provide subsistence and cash for its members, whilst the farm-firm relies mainly upon the household for its labor needs and often also for purchased inputs. Thus, too, production objectives typically are constrained by a need initially to meet household needs rather than provide for the market, whilst family labor is constrained, at least during the agricultural season, from seeking non-farm employment. Similarly, the cash resources available to the farm are interdependent with household consumption and investment decisions. In general, decisions on economic and non-economic activities of the farm-firm and the household have to be considered together.

* Senior Agricultural Economist, World Bank, Washington. The views expressed in this paper are personal ones and do not necessarily reflect Bank policies or positions. I am grateful to Wilfred Candler, Uma Lele, I.J. Singh and Paul Zuckerman for constructive comment on an earlier version and to Susan Stevens for drawing the diagram.

It is convenient to make the simplifying assumption that the basic decision-making unit responsible for these joint activities is not only consistently the same for household and firm, but also is clearly identifiable. Neither assumption is necessarily true. Most often, the production and consumption unit is the primary family, comprising a man, his wife or wives, and their unmarried children. The family, the house, the household and the farm exactly coincide and the male head of the family is typically the decision-maker. However, the basic family unit may be extended to include married children and their families and/or other relatives: this may or may not embrace an entire living unit. 2/ Alternatively, the economic unit may embrace more than one primary or social unit either for all decisions or, as where clan elders or age-set heads have specific responsibilities, for some decisions.

The various forms of socio-economic organization need not concern our argument if the decision unit embraces equally both domestic and all economic activities. But a division of labor and of decision-making both between domestic and farm activities and within farm production is common in Africa. Where the latter division is along crop (rather than functional) lines, the major decisions on levels of resource use and techniques of production may be divided between communal activity and private activity, or between men and women, even to the point of having modern production methods operating side-by-side with traditional techniques within the same farm unit. Often subsistence crops are the women's responsibility while cash crops (especially introduced cash crops) are tended by the men who also dictate the distribution of the proceeds. 3/ Even if techniques remain similar, the division can affect resource use as when men and women are working at very different intensities at any one time because of the varying seasonal demands of different crops. 4/

For ease of exposition, it has been convenient to assume the "family" to be a homogeneous decision unit.

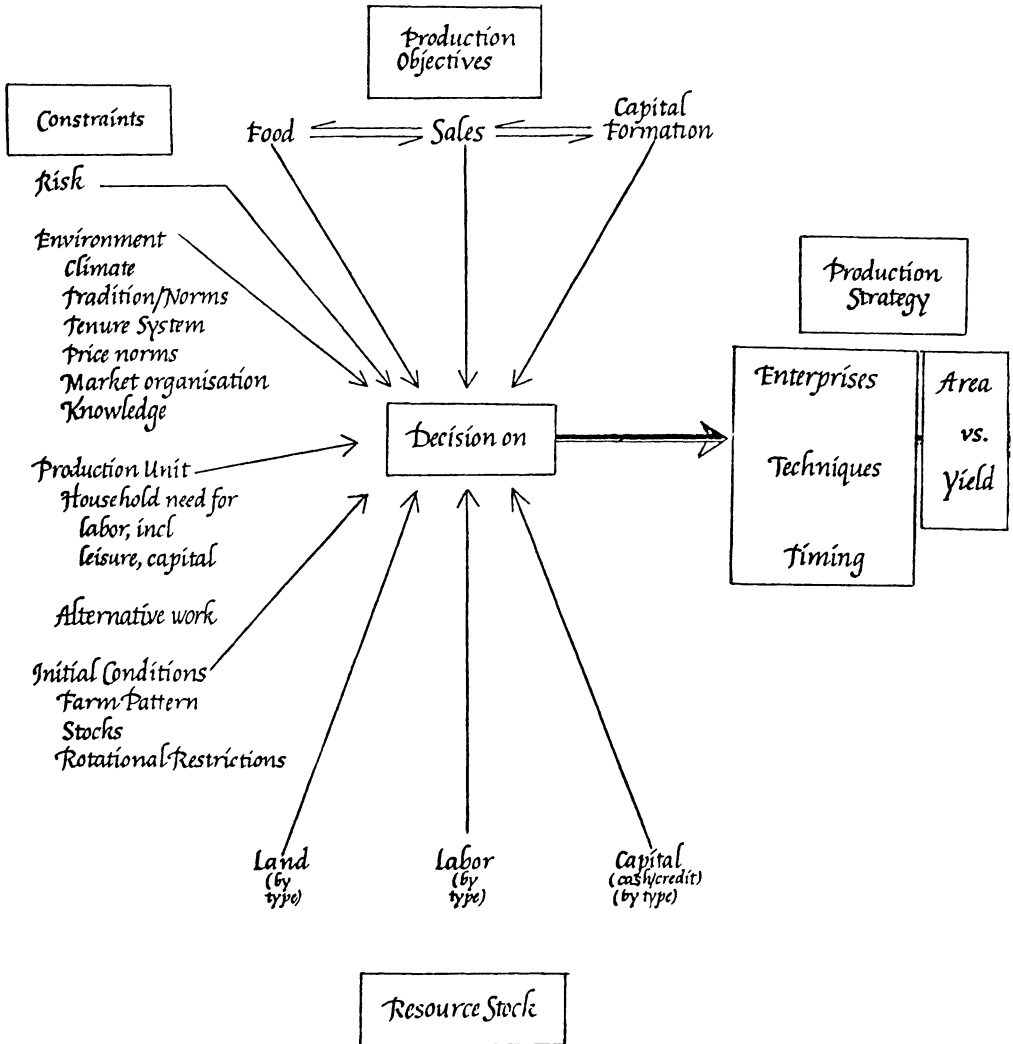
The Decision Framework

It has also been necessary to limit the range of objectives and constraints discussed to those most directly impinging on the production decision. A simplified representation of the African farm-firm decision matrix is given in the diagram. It introduces the interdependent household decisions as constraints which, together with a range of exogenous factors, will act upon both the resources available for production and the farm objectives, and will, therefore, influence the choice of crops and techniques, the central area for decision by the farmer.

All of these have to be considered within a specified time-frame, and, as we are concerned with a dynamic process, the influence of the various factors will vary over time in response to changes in relative values. Again for simplicity, the discussion assumes that the decision period is a year. It should be recognized, however, that within this there is a shorter term (typically daily) decision-making activity, which is concerned with the immediate action on the farm. In daily decisions, there may be much less

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THE DECISION FRAMEWORK (FOR THE ANNUAL STRATEGY)



flexibility in resource availability; and the choice of crop and, probably, choice of technique is given. Many exogenous factors which were major influences on the annual cropping strategy become minor influences on the daily operation whilst the immediacy of (say) a need to harvest or prepare food, obtain cash, carry out a domestic chore, or the effects of a rainstorm become dominant factors in the daily decision. The aggregate of such decisions will only match the pattern of the longer term decision framework if the decision-maker has accurately anticipated his resources, needs and exogenous influences. 5/

Resource Availability

Essentially economic decisions are concerned with the allocation of a stock of resources to productive activity.

The relative factor proportions at the farmers disposal--the land/labor/capital ratios--are major determinants of choice of crop and technique. Conditions in Africa vary enormously from area to area and from decision unit to decision unit, but if there is one valid generalization, it is that in African smallholder agriculture, with land only recently emerging as a significant constraint, labor is of overwhelming importance, and decisions on the use of the family labor stock are critical.

Labor

The effective size of the labor stock depends on family size and composition; the latter being important not only because of physical capacities which differ according to age and sex, but also where tradition associates enterprises or functions with a particular sex or age group. The interdependence of the household/farm limits the total stock of labor available to farming and may also alter this balance between types of labor available, and so strongly influence the enterprise mix or techniques used. Thus in the Gambia, more rice would be grown if female labor were available, and less millet (on which men work): 6/ in Toro, Uganda, women householders cultivate proportionally less bananas but more beans and sweet potatoes than male householders. 7/ Absence of children at school may restrict cattle herding, and the reduced labor for bird-scaring has been a factor in changing the crop pattern in the Gambia and Sierra Leone. 8/ The shortage of particular types of labor may also lead to adoption of labor-saving technology, even where overall the man: land ratio is high, but a more frequently observed reaction is a breakdown of the traditional specialization of labor. 9/

Depending on the degree to which his area is exposed to a wider market, the farm decision-maker may allocate his stock of labor between leisure and a range of productive activities. The latter clearly include agricultural production (in its broadest sense to cover livestock and fishing, work on stores, hunting and gathering activities), wage earning, and other cash-producing activities. They must, however, also be extended to embrace a range of household and social activities which are less easy to value but which are no less important and which, in many societies, may be partly or wholly performed by non-family specialists or are provided within the

accepted social infrastructure. Thus the collection of domestic fuel and water, food processing, house construction and repair. Less obviously, labor may need to be diverted to judicial functions (which elsewhere would be carried out by a lawyer or judge), to social calls with political or security significance, or to marketing functions for which in other societies it would be normal to pay someone else.

The pattern of crop agriculture in tropical Africa is largely set by the seasonal pattern of rainfall, but many non-crop pursuits can and typically are timed to avoid conflict with agricultural work. Marriages and other controllable ritualistic activities are in this category, but others may be seasonal and directly conflict. One such is the collection of thatching grass, which occurs at the harvest-time for crops: this is probably the reason why one of the first cash investments typically made on the African farm is a metal roof for the house. Domestic chores make relatively uniform demands all the year and their influence is more to reduce the total stock of labor available for farm operations or outside work than to create a seasonal bottleneck. The identification and valuation of this range of non-farm demands on time, separate from physical repose, is important because, to the extent that it does conflict with farm work, it raises the opportunity cost of agricultural work. It therefore reduces the readiness with which the flow of labor into agriculture can be increased (compared with a situation in which the only decision in labor allocation is between resting and working) and, in consequence, influences the choice of crops and techniques. Moreover, because non-farm activities reduce the time available for rest, the marginal value of pure leisure is also raised: thus a greater incentive is required to encourage the farmer to sacrifice leisure for agricultural work. The values which farmers place on different activities are difficult to define, particularly because the reporting of non-farm activities is inadequate in many studies.

An examination of the relative elasticity of substitution of labor between farm work, non-farm activities and leisure, using data from studies of two areas in Uganda into which tea had been introduced as a cash crop revealed a tendency for farmers' wives in both areas to reduce their leisure time when more work was done in the fields (possibly because there was little reduction possible in the domestic tasks that occupied two-thirds of the day-light hours they spent on non-agricultural work). However, the householders themselves tended to give up a range of non-farm activities, including wage labor, rather than reduce their leisure. 10/

In general, there are limits to the inroads which agriculture can make on the household labor resource. A review of over 50 detailed studies of tropical African farms shows that typically only about 1,000 hours per year per adult worked are spent in the fields even where there is an apparent effective demand for surplus produce. 11/ Clearly the extreme seasonality of the tropics is a factor in this, but as seasonal peaks are typically under 25 hours a week and rarely reach 40 hours 12/ it appears, at least a priori, that the off-farm, non-cash-earning uses of labor have sufficient value to bid labor away from agriculture. There could, of course, be other constraints operating: a lack of complementary resources; constraints which stem from traditional norms; or objectives which are limited because consumer goods are not available.

The short-run elasticity of supply of family laborers is clearly low. On the up-side, some increase in labor supply is possible from transfers from alternative uses, including the postponement of activities--even of time-off for sickness ^{13/}--and rather more flexibility may be realized from changes in the length of day worked. There is plentiful evidence that during the agricultural season, the day does vary considerably and that the farmers' decision on how long to work is a trade-off between the effort involved in physical labor and the urgency of the operations as measured by returns foregone by untimely work. These latter may be considerable: recommendations on early planting, timely weeding, and optimum harvesting dates abound and are based on just this fact. An analysis of data from Tanzania showed that inspite of the relative arduousness of land preparation and weeding work compared with cotton picking, in calorie consumption terms, three times the effort devoted to picking was applied to cultivating, and twice the input went to weeding even taking rest periods into account. ^{14/} On average, the total day in which cultivation was the major activity was 40-50% more strenuous than one in the picking season. This, incidently, increases the demand for food at a time when it is in relatively short supply.

Land and Capital

The amount of land relative to labor available has obvious influence on a farmer's decisions: where land is short higher yielding crops and yield-enhancing techniques are used. To satisfy the food objective, the criterion for crop selection, at least for the starchy staple, is calorie yield. This tends to mean change towards cassava and other roots from grains, and to rice and maize from millets and sorghum among the grains. ^{15/} Similarly, the availability of particular types of land are determinants of choices of crop combinations with such obvious extremes as groundnuts on sandier soils and rice on swamp. Farm boundaries may be carefully drawn to ensure a range of soils, as is found in parts of Sukumaland, Tanzania, where farms typically lie down the catena.

The rationale for credit schemes is usually that lack of capital as a complementary factor is limiting the farmer's choice of crops or range of techniques (although in reality, it may be the poor supply of an input rather than the means to buy it which is inhibiting). ^{16/} Capital inputs frequently operate indirectly by raising labor productivity and thus induce increased labor allocation to agricultural production.

The Farmers' Objectives

The purpose of farm activity, as of every other economic activity, is consumption of goods and services within a defined time-frame. The range of objectives may be viewed as production for direct consumption on the farm, particularly of food; production for sale or barter for goods or services which either cannot be produced within the family or for which there is comparative advantage in exchange; and investment to enhance future consumption.

The Food-crop/Cash-crop Decision

The importance attached by African farmers to securing an adequate food supply as a primary objective is well-documented. It shows particularly in the extent to which even farms with well developed production for market continue to produce all or most of their subsistence requirements. ^{17/} The choice clearly reflects risk aversion in a situation of unreliable marketing organization and is reinforced by the wide gap between buying and selling prices for identical or readily substitutable foods. This is further strengthened when the spread in prices is accompanied by year-to-year variations in prices and crop yields. ^{18/} Not only does the overall cropping pattern of the African farm reflect the food-crop/cash-crop decision, but the choice of crops and the timing of operations are also interrelated. Thus, in Machakos, Kenya, it was shown that beans appear strongly on a farm plan because of their short growing period, and similarly, in the Lower Shire of Malawi, sorghum, and millets (although producing less grain per unit of land or labor) matured earlier than maize and were thus included on the farm for the contribution they could make to the diet when food would otherwise have been short. ^{19/} A desire to maintain an even supply of such preferred foods through the crop season may also enter into the cropping and seasonal labor-use decision.

The allocation of land and labor to food crops will not only depend on the average yield of those crops, but also on the reliability of that yield, enough food being widely recorded as a prime goal of farmers. ^{20/} This implies that in "normal" years, the risk averting farmers will produce a surplus ^{21/} (and the surplus carried over from the previous year will influence the decisions on resource allocations and crop choice the following year). As foods are rather widely substitutable, and as susceptibility to yield variation from any one cause differs considerably between crops, a range of crops will normally be grown. Although farmers will plant enough to give some surplus over and above family requirements if yields are "normal", they can be expected to try to judge the situation rather carefully, for unless there is a ready market for surpluses, resources devoted to their production will be largely wasted in storage losses. An increasingly common solution to this problem is the inclusion of cassava in a farmer's plans even where it is not a preferred food because this introduced root, now found throughout the African tropics, can be stored in the ground, without attention and without deterioration, for up to five years.

Food-crops and cash-crops (to continue with this rather false dichotomy) may be complementary, as for example where a rotation of crops is needed for either soil nutrition or disease control. More important, crop types and/or crop ratios may be adjusted to accommodate the introduction or expansion of a marketable crop in the face of resource constraints, particularly of seasonal labor. Thus, the introduction of cotton has been variously reported as a factor in a switch to cassava from millet and maize, and to plantains from millets. The adoption of new techniques may also influence crop decisions (the introduction of ox-ploughs was reported as a major influence in a switch from sorghum to maize by the Tonga in Zambia, whilst introduction of a new process for flour production lead to increased planting and consumption

of maize by the Azande of the Sudan 22/), and a need for liquidity from the sale of a short-term crop may also influence the enterprise mix.

Although there was a lively exchange market within most African economies prior to the colonial period, 23/ the quite remarkable growth which has taken place since then has been lead by a response to new export markets and has been achieved principally by bringing readily available land into cultivation and the commitment of more family labor to agriculture. A major consideration in the decision to expand cash crop enterprises, and in the choice of cash crop, has been the return to family labor relative to other uses, including alternative economic activity (whether for wages or profit), unpaid non-farm activity (including domestic duties), and leisure. Prices and market conditions for both the farm product and the goods and services for which the product may be exchanged and increasing exposure to new consumer goods become important considerations in the cash crop decision, in which the priority desire for reliable food supplies becomes an important constraint. The response to these competing demands, particularly for labor, may be seen in the technically sub-optimal techniques by which the crops are grown. There is convincing evidence that timing, intensity, and nature of farm operations which differ from technical recommendations, and which are the bane of extension workers, are frequently rational modifications reflecting farmers' valuations of costs and returns in the complex milieu within which they operate. Thus, cotton is recorded as planted late and over an extended period principally to avoid peak labor demands; groundnuts are weeded late but perhaps more intensively with the same objective; and intensity of land preparation may be traded against intensity of weeding in grain crops. Frequently, modification in timing and substitutions of techniques among crops will be complemented by changes in the crop mix--a combination of groundnuts and cotton may facilitate more even labor use than concentration on groundnuts: root crops tend similarly to be more readily integrated with a cash crop than grains. Major switches may take place in the farm pattern in response to an incentive to change a single enterprise. 24/

Capital Formation

The African farmer like any other producer has a choice between consumption now and more consumption later and therefore his range of objectives will include some capital formation, largely derived directly from the input of labor. Building and land clearing are frequently carried out in the dry season when the opportunity cost of labor is low, and, being subject to few constraints, may have little or no influence on choice of crops or techniques. But the introduction of a perennial crop, the work on which has to be done in competition with annual and other crops, could be severely limited by, or necessitate major changes in, the pattern of farm operations both during the period before it produces returns, and after it becomes an established crop. This pre-production period may be 4-5 years for crops like coffee and tea, but such crops have been readily established by smallholders where flexibility on the subsistence side has been provided by plantains or root-crops with their non-seasonal labor demands, or where a non-agricultural activity provides support in the establishment period. 25/ Investment in long-term crops as a response to price incentives is well documented. 26/

The Constraints

A central issue for those trying to improve the efficiency of African agriculture is the impact of constraints which indirectly, through their influence on resource availability or on the farmer's objective, impinge on the farmer's decisions on crops, techniques and timing, and thus on the level and nature of production and the acceptance of profitable innovations. The range of influences on a farmer's plan of operation is enormous and closely interrelated. 27/ For convenience, they may be classified into (a) the physical and economic environment within which the farmer operates, (b) the starting conditions facing the farmer in formulating his production strategy, (c) the nature of the household/farm production unit and in particular, its competing demands for family labor both for domestic and other economic activity, and (d) the perceived risk of departures from climatic and market norms.

The Production Environment

Climate, and in particular the level and pattern of rainfall, is a dominant influence on the tropical agricultural cycle. By its influence on plant, weed and pest growth and on the physical conditions of the land and crop, climate and weather conditions will impinge on enterprise choice, techniques used and flexibility in timing of operations. Above all, they will influence the level at which labor becomes restrictive, and behavior patterns in African agriculture can be seen particularly as responses to seasonal pressure on the labor resource, caused by a need to accomplish a variety of operations on a range of crops within a restricted period--a growing season of 5-6 months is common. 28/ Weeding frequently appears as the single most important cause of seasonal pressures and particularly where oxploughing is used, not only because areas opened are greater but also because weed-covering at land preparation is generally poorer than with hand cultivation, especially with ridge-cultivation.

Tradition and cultural norms influence economic behavior in any society. In societies where the social and production unit largely coincide and production is largely for direct consumption, this becomes particularly apparent. Thus crops grown and methods of farming tend to vary more between tribes than within tribes, influenced by, e.g., religion, varying views of the role of women, attitudes to livestock, and tenure systems. This is well known and suffice it to make one point: that traditional methods and social organizations are far from being rigid barriers to change. Thus, even staple foods will change. Cassava has been recorded replacing the preferred yams in Nigeria; millets have given way to plantains in Uganda; to maize, or to rice and maize, in Tanzania; and to rice in the Gambia. 29/ Traditional division of labor by function or crop, which may be seen as a form of disguised unemployment in traditional systems, is rapidly modified when the opportunity for new profitable employment, on or off-farm, appears. Such change has been reported from all parts of Africa. Similarly, communal labor systems (which have a reputation for being inefficient) may break down in the face of the introduction of a new technique or crop. 30/

Farm decisions are also sometimes made on the basis of superstitions. Most widespread and important are food taboos typically prohibiting eggs and other sources of protein to women and children, thus marginally affecting production decisions, but with more serious impact on nutrition. Farm operations may be guided by superstitions: thus among the Azande, weeding of sesame is prohibited because of an alleged connection with crop disease; in the Gambia, it was considered unlucky for women to farm in the swamp on Mondays and for men to farm on Wednesdays; and--perhaps more readily explicable--timing of planting by movements of the stars and the emergence of several species of white ant are recorded for the Lango area of Uganda. 31/

Land tenure systems may also constrain production and may be difficult to change without direct Government action. However, traditional tenure is usually secure and is rarely an inhibiting factor in the introduction or improvement of perennial crops, although communal land-holding is a major barrier to livestock improvement in Africa. On the other hand, in Buganda, Uganda, a freehold system introduced by the colonial power greatly facilitated the change from subsistence to commercial farming, but the very security of tenure it offers has more recently inhibited change. 32/

For crops for which there is an effective demand, price expectations will be a major determinant of production decisions, as will the reliability and efficiency of the market organization, embracing such considerations as time of payment for produce or of delivery for inputs. The farmer's knowledge of these norms as well as of use of inputs or growing techniques are presumably major influences on production levels for it is to these areas that extension services address themselves. Perhaps one reason why their impact has been less than might have been expected is that they approach the farmer with an inadequate appreciation of the multiplicity of factors which affect his production strategy and with advice too little adapted from research findings to the farmer's resource constraints. If there is no possibility of marketing even part of a crop--probably a rare occurrence--and it is grown with family consumption in mind, there would be no reason for market prices to influence the choice of crop. In this case, tradition, taste, biological risk, rotational considerations or the advantages of an even labor input (or one which is complementary to the demands of other crops) will be dominant influences.

The Nature of the Production Unit

We have already touched upon the importance of the interdependence of the household/firm as a limitation on resource availability for agriculture, and particularly on the availability of the key factor, family labor. A few points arise. First, if the value of domestic occupations can be reduced, or if they can be carried out by specialists, then new resources may become available for farm work. Thus, such investments as water supplies, grain mills, roads which speed transport to buying points, the building of storage, changes in the judicial function, or making building poles or corrugated sheets available for roofs may all be worthwhile objectives for those attempting to reduce constraints on the growth of agriculture. Second, just as the farm can be the source of capital for non-farm enterprises, 33/ so the converse may be true. Shopkeeping, wage-earning and salaried jobs are frequently

reported as the means of establishing agricultural enterprises, and as these often involve relatively innovative people, limitations placed on such a pattern of development may inhibit a particularly progressive contribution to agricultural growth. 34/ Third, there is widespread evidence that the institutionalized obligations of members of traditional societies to share surpluses above immediate needs among their close kin inhibit the production of new crops and the adoption of new techniques. 35/ Against this, however, the very imperative to attain wealth to distribute in order to establish a following may encourage innovation. Haswell argues that adherence to a village communal work structure provides social security in a milieu of variable crop yields, and Hill avers that in Ghana, the mutual insurance of the lineage structure provides a positive impetus to cash crop development. 36/ (It is also clear, however, that even if obligations exist in tradition, they are not necessarily fulfilled).

Initial conditions

In any production period, a farmer's decisions will be tempered both by past decisions which have established a farming pattern that is not readily variable, and by his stocks of food which will affect his production objectives. Somewhat less inflexibly, there may be technically defined limits to his cropping pattern because of a need to maintain the nutrient status or structure of his soil, or combat pest or disease buildup.

Risk

One of the most illusive and undoubtedly one of the most important influences on farm decisions is the farmer's perception of, and attitude to, risk--themselves a function of any number of personal and social influences. Risk may be viewed as uncertainties over yields, influencing all crop decisions but particularly subsistence crops; price uncertainty mainly modifying cash crop decisions; and risk of loss or non-availability of resources which probably particularly affects acceptance of purchased inputs and tends therefore to involve cash crops. The closer a farmer is operating at an absolute minimum level of subsistence (which it will be his prime objective to protect) and the more limited is his resource base, the greater will be his aversion to risk, for risk levels are highly relative. It is not, therefore, surprising that the African smallholder, however much an economic man, frequently is found unresponsive to innovations which will bring about only marginal gain and instead seems to look to a critical minimum level of benefits before adopting a new technique. 37/ This phenomenon probably contributes to the idea that African farmers seek a target income. 38/

It is difficult to judge the level of risk facing the African farmer, and it would be surprising if he himself could assess it closely, but his farm plan will certainly take it into account. Yield risk is great: a combination of unfavorable levels or timing of rainfall, possibilities of pest or disease attack, or damage by predators or hail-storms. An example of the yield risk to which farmers are exposed has been recorded in the Machakos area of Kenya where the ratio of good to bad years for pigeon peas was 3:3; for maize 3:4 and beans 3:7, 39/ whilst for the admittedly more

marginal Karamoja District of Uganda, total crop failure was experienced seven years out of 29 and poor to fair yields in a further nine. ^{40/} In Geita in Tanzania, late planted maize fails two years in three. ^{41/}

Price risk is probably less than yield risk, particularly for crops sold on formalized markets where guaranteed minima are frequently set. When, however, these minima become de facto fixed prices, the guarantee destabilizes the farmer's income from crops with variable yields and increases his relative loss in a climatically bad year. Price risk also applies to purchased consumption goods, particularly foods, and as retail prices tend to fluctuate in response to demand and supply conditions, this reinforces the decision to home-grow at least staple foods.

The danger of loss of resources committed to production is particularly significant for cash applied to purchased inputs. If this represents a large proportion of the farmers' cash reserve, its loss will inhibit further attempts at innovation. The same reserve is probably also for use in family emergencies, and this too will discourage its commitment to any but the surest new technique. New crops, or changes in crop ratios, typically require less purchased input than new techniques and perhaps for this reason, appear to be more readily accepted. ^{42/} The risk of non-availability of complimentary resources once production has started seems to be poorly documented: it arises from such phenomena as illness reducing the family labor supply; the non-arrival of anticipated seasonal hired labor; failure of input supplies to materialize; or breakdowns in extension or animal health services.

Risk reduction typically means diversified cropping patterns, the use of few purchased inputs and home growing basic foods, whereas earning maximum long-run income involves specialization in cash crops, using modern techniques. ^{43/} That the African farmer typically pursues the former course, at the cost of earnings, may be fully rational behavior within the framework of his utility function, for the quest for greater family income is likely to be tempered by a desire for economic stability and social continuity.

The Production Strategy

Thus, within this framework of a stock of resources applied to achieve his production objectives, the farmer is faced with a range of constraints which will influence his decisions on what to grow, how to grow it, and when. The possible combinations are innumerable. One of the most impressive and consistent features of African agriculture is the modification of farming systems in response to the incentive to develop the farm or respond to alternative economic opportunities. Modifications may be in the timing, intensity and nature of farm operations and in the cropping pattern.

A few cases will illustrate the point. ^{44/} In northern Uganda, it was found that although early-planted cotton would provide the highest yields, planting was typically both delayed and spread through the growing season apparently in order to reduce risk from hail which occasionally hits at harvest time and to avoid labor conflicts especially with millet weeding. Other possible modifications were row-planting or millet to reduce weeding labor (but at some cost of greater inputs at planting time), and a switch

of millet from the first to the second rains, possibly at the cost both of dropping sesame from the farm plan, and of abandoning the tradition of paying communal and hired labor with millet beer. There were also signs of millet itself being replaced, especially by plantains, and, because the full benefit of both insecticidal spray and fertilizer applications is dependent on early planting, this may gain in acceptance and result in increased specialization in cotton accompanied by purchase of a greater proportion of staples.

In the Gambia, it is recorded that more intensive later weeding and a higher seed rate were employed in substitution for a lower intensity of weeding earlier in the season: early weeding was the recommended practice but it falls in the busy months. Substitution in the timing of an operation or between operations appears to be widespread: this is especially true of land preparation and weeding. The adoption of ox-ploughing without simultaneous introduction of ox-weeders (which in turn necessitate cropping in rows, probably in pure stand) may lead to additional demands for weeding labor.

Pure stand cropping is, in fact, unusual in Africa, especially for food crops, and intercropping is adhered to in spite of years of extension "advice" that it reduces yields and is, therefore, undesirable. There is growing evidence that the decision to intercrop is a rational one. In a comparison between the magnitude and variability of returns to land and labor under pure cropping and intercropping, Norman ^{45/} demonstrated that although per acre yields were generally depressed by intercropping, this was usually because of reduced plant density and not because of lower per stand yields due to plant competition for light or nutrients. In value terms, a mixture gave a better than 60% increase in gross returns per acre. This was at the cost of a similar increase in labor inputs so that overall returns per man hour were unchanged, but gross returns to labor in the two months identified as the period of peak demand were increased by over 25%. When questioned, farmers rationalized intercropping particularly in terms of maximizing returns to land. Generally in the study area--near Zaria in Northern Nigeria--seasonal labor rather than land was found to be constraining but this varied from farm to farm and both land and labor considerations probably operated as major influences on farmers' decisions to intercrop. In net profitability terms, whatever way costs were measured, intercropping came out consistently and markedly better than sole cropping: there was also evidence that it gave more reliable returns as well. Given indigenous technology, and given farmers' present goals, resources and conceived constraints, the decision to intercrop is rational, and sets up a case for devoting some technical research to ways of improving production within intercropping systems instead of basing all work on pure stand conditions. More economic research is needed too, following Norman's approach, on the relative profitabilities of intercropped and sole crop systems.

Crop mixes and ratios are also capable of infinite change, generally in favor of maize, cassava and rice at the expense of millet, sorghum and yams, with plantains occupying an intermediate position, sometimes coming in to replace grains and sometimes declining in favor of roots. Particularly interesting simultaneous adjustments of both crop ratios and techniques were noted in the Gambia resulting from outside employment opportunities for men

and increased school enrollment of boys. Rainfed cereals were reduced in favor of swamp rice and the remainder grown closer to the village; cultivation practices were intensified by use of manure on the relatively poor soils close to the village; and division of labor broke down as men began to help women with the extra rice.

The major decision factor in this case was shortage of labor and in particular, of one class of labor. Other determinants in choice of crops include population pressure on land and related soil impoverishment; risk of loss from bird or pest attack, or disease; the introduction of new production techniques such as ploughs or of new processing methods; direct competition for particular soils or irrigation water from introduced cash crops; and shifts in relative prices or changes in the marketing structure. The introduction of cash cropping has undoubtedly been the major cause of modifications to traditional production patterns in the twentieth century and the major determinant of the type of change has been the relative availability of land or labor.

Research Needs

We have discussed a framework which relates major determinants in decision-making by African smallholders, and have given examples of decisions, made in response to these factors, which appear to be rational. We have, however, little knowledge of the relative values of the determinants as they impinge on the response of farmers to innovations and incentives offered by change agents. This would be a fruitful area for further research. To date, most work on adoption has been addressed to identifying who innovates or adopts as defined by such characteristics as education, age or land ownership, 46/ but little either on the relative weight of the specific factors influencing decisions on any one farm or in any group, or on the sequence of adaptation to new crops and techniques.

There is value even in a rather simple listing and subjective valuation of the various decision elements, for it is to these that change agents of all types should address themselves in their attempts to provide advice and inputs which will be helpful to the farmers. Too often advice has been developed on false assumptions as to the critical constraints, or with lack of appreciation of conflicts between crops or of production alternatives, and there may be a bigger payoff, for example, to removal of price or marketing risk, than to the creation of an elaborate extension organization.

It is important too that planners or investors should understand the decision framework if they are to assist the development process which has, as its objective, an increase in the welfare of the rural population through enhancement of their ability to produce. There is a need to know for example, how critical is the credit constraint before elaborate credit programs are established; a need to know the directly production impact of the provision of water supplies and not only its impact on health; a need to base crop research on problems which farmers perceive as critical; a need to understand the interaction of factors impinging on farmer's decisions so that the approach of the extension services can be more fruitful. There is

thus a need to investigate further the importance and level of non-farm social and domestic activities and the extent to which they inhibit change or are readily overcome when profitable alternatives appear. A related subject is the interrelationship between agricultural and non-agricultural economic enterprises; the extent to which such enterprises are a source of capital for the farm or the farm provides the inputs for investment in non-agricultural production. It would be interesting to see a model of risk aversion, such as that developed on Indian data by Schluter and Mount (1974), for the African scene; and an area of risk effects which does not appear to have been studied is the risk of non-availability of resources when needed. Another, not widely examined, is the inhibiting effect of the high-cost and inefficient centralized service and marketing organizations which have become such a common feature of the farmer's environment. Work on the introduction of improved technology to technically sub-optimal systems could be taken further, and specifically, the investigation of economic responses in intercropped systems and with crops planted late could have a high payoff. The importance of farmer's subsistence goals as a cause of inefficient allocation of resources does not appear to have been examined in the African context. Above all, further investigation is needed into the relative weights and values attached to the specific influences on farm decisions and on the sequence of adaptation to new crops and techniques.

In the approach to such work, one thing is clear: because of the complex interrelationships of objectives, constraints and resource levels on the one hand, and enterprises, operations and timing on the other, the farm must be viewed as a whole. Moreover, given the identity of the production and consumption unit and the interrelations of resources and activities within each, the farm and household must be considered together, by researcher and agricultural practitioner alike.

Although African farms are small in terms of resources or output, they are highly intricate entities and the process of decision-making on them is as complex as it is in any larger unit.

FOOTNOTES and SOURCES

- 1/ An excellent quantification of differing technical efficiencies among a group of Tanzanian cotton farmers is provided by Shapiro (1976). This phenomenon is believed general (Cleave, 1974, p. 202) but runs counter to the widely accepted hypothesis of Schultz (1964, p. 37) of efficient resource allocation. It need not conflict with the strong evidence of two decades that African smallholders are economic men: for, whilst the direction of response is clear, and in nature economic, the complex interactions of objectives and constraints discussed in this paper make judgements on the overall efficiency of farmer's decisions extremely difficult.
- 2/ Thus, among the Maninka of Mali, the basic unit for production and consumption is the Lu, usually the families of a man and his younger brother who live within a single compound. Families range in size from 3 to nearly 100, although 10-15 is typical. The senior male is the decision-maker for activity on the lu field, or foroba, which provides the basic subsistence. The lutigi does not, however, make decisions on individual cultivation which is permitted once the essential needs of the lu are assured (Jones, 1972). Among the Hausa of Northern Nigeria, the economic unit is the gandu, defined as "those persons eating from one pot," but there may be one or more gandaye to a compound. The gandu head is the economic decision-maker (women in this moslem area typically only engage in agricultural work in the poorest families) (Norman, 1967 (1), p. 5).
- 3/ See e.g. Kimmerling, 1971. In Machakos, Kenya, Heyer (1966, pp. 41-42) found that "each wife has complete responsibility for the cultivation and produce of her own plot of land and she makes all her production decisions alone. The head of the homestead does the same for his plots. There is little cooperation..." In the Yoruba area of Nigeria, wives tend to conduct their separate business to such an extent that the family unit becomes economically a set of sub-units (Galletti et al, 1956, pp. 277-278). The dichotomy between subsistence and cash crops is more useful than real and is used here only for simplicity.
- 4/ This is well illustrated by a case in the Gambia where in two periods in which women put in their peak labor effort on paddy--a crop not at that time handled by men--the men's labor inputs were some of the lowest in the whole year. (Haswell, 1953, pp. 37-38).
- 5/ The distinction between influences on longer-term decisions and daily actions is well brought out by Zuckerman, 1973.
- 6/ Haswell, 1953, pp. 8-9.
- 7/ Pudsey, 1967, p. 8.
- 8/ Reported by Haswell, and by Finnegan, 1965, p. 134.
- 9/ Cleave, 1974, pp. 170-173.
- 10/ Cleave, 1974, pp. 157-160.
- 11/ Cleave, 1974, pp. 31-65.
- 12/ Cleave, 1974, p. 127.
- 13/ Cleave, 1974, pp. 175-177.
- 14/ Cleave, 1974, p. 58.
- 15/ Among many examples, in the Usumbara Mountains in Tanzania, the proportion of land planted with cassava increased as the size of holding de-

- creased, whilst maize cultivation was determined by the cassava cycle (Attens, 1968, pp. 150-2).
- 16/ Heyer (1966, p. 78) found both the overall availability of seed a periodic constraint on the amount of crop grown and the variety of seed an influence on the crop mix following poor years.
 - 17/ An examination of studies of 31 areas for which food production levels could be quantified showed that, on reasonable assumptions, 21 produced all their subsistence. Although nearly all were growing cash crops for sale, most of them were selling at least half of total output. Of those relying on the market for food needs, Yoruba cocoa growers and oil palm farmers of Calabar had the highest real income of any of those studied whilst tea growers in Uganda also had extreme commitment to the market economy. Even so, on average even in these areas, at least half of subsistence needs were farm-produced (Cleave, 1974, pp. 28-29, 212-221).
 - 18/ The extent to which subsistence production represents an inefficient allocation of resources at farm level could be a fruitful field for research with direct bearing on returns to improvements in marketing practice (Cleave, 1974, pp. 221-222).
 - 19/ Heyer, 1966, p. 197; Catt, 1965, p. 40.
 - 20/ For example for Sukumaland, Tanzania (Collinson, 1964, p. 7; von Rotenham, 1968, p. 57); in Buganda (Foster and Yost, 1967, p. 13) and Acholi (Oloya et al, 1967) in Uganda, among many.
 - 21/ Allan, 1965, pp. 38, 47-48.
 - 22/ de Schlippe, 1956, pp. 94-5, 277.
 - 23/ Probably only palm oil, mainly from Nigeria, had a significant history as a nineteenth-century export cash crop (Cleave, 1974, pp. 222-3).
 - 24/ Cleave, 1974, pp. 131-144.
 - 25/ Investment of non-farm earnings was important but not universal in the establishment of tea in Toro, and of coffee in Buganda. In Nigeria, a major development of commercial farming has been by civil servants and businessmen.
 - 26/ Relevant studies include: for cocoa, Bateman 1965; for coffee, Maitha, 1969; and for tobacco (long-term because of the fixed investment required) Dean, 1966.
 - 27/ See Zuckerman, 1973 (pp. 83-84) for a detailed diagrammatic presentation.
 - 28/ The influence of climate in African agriculture is summarized and responses to seasonal labor conflicts are analyzed in Cleave, 1974 (pp. 67-72; 113-144).
 - 29/ See: Oluwasanmi et al, 1966, p. 84; Johnston, 1964, p. 54; Collinson, 1963, p. 38 and Baum, 1968, p. 24; Haswell, 1963, pp. 39-41. Johnston, 1958, pp. 222-224 quotes a number of other examples.
 - 30/ As in Northern Uganda with the adoption of the ox-plough (Okai, 1966, p. 3) and in Tabora Region of Tanzania with the introduction of tobacco (Scheffler, 1968, p. 289).
 - 31/ Gambia: Haswell, 1953, p. 16; Azande: de Schlippe, 1956, p. 127; Lango: Watt, 1966, pp. 4-5.
 - 32/ See: Richards et al, (1973) especially Chapter 3. Other factors in the rapid commercialization of Buganda included a readily available labor supply from neighboring areas, its position embracing the administrative and communications center of Uganda, an authoritarian indigenous political organization able to initiate change, and a beneficent climate.

- 33/ It has been noted in the Lilongwe Land Development Project area of Malawi that the majority of shops blossoming in consequence of the development of the area are owned and operated by former full-time farmers. This is a widespread phenomenon.
- 34/ In Uganda, considerable tea development was by shopkeepers, politicians and civil servants: similarly many of those who developed coffee in Buganda in the 1950s started in non-agricultural occupations. (Richards et al, 1973, Chap. 11).
- 35/ See e.g. Gerlach, 1965, p. 255; Pudsey, 1966, App. Q; Tuthill, 1968 p. 28.
- 36/ Haswell, 1953, p. 15; Hill, 1963, p. 2.
- 37/ See for example: Attems, 1968 and Ruthenberg, 1968, pp. 164-65, 348-9, and Fogg 1965, who suggests that a return of 2:1 on capital is needed to establish new techniques.
- 38/ This does not imply that objectives are unlimited in any one period; aspirations expand as the chance of achievement expands but once a higher level is reached, every effort will be made to maintain it. See Duensenbury, 1967 and Yudelman, 1964, p. 176.
- 39/ Heyer, 1965, p. 3.
- 40/ Dyson-Hudson, 1966, p. 42.
- 41/ Collinson, 1964, p. 7.
- 42/ An observation made by Pudsey in Uganda (1967, p. 1) and Ruthenberg for Tanzania (1968, pp. 343-347).
- 43/ This is well brought out in a risk aversion model applied to Indian data by Schluter and Mount (1974) who found that farmers were operating close to the product possibility curve, but low down on it at a level which reduced risk but also returns. The same technique used on African data would probably produce similar results.
- 44/ These are summarized from Cleave, 1974, pp. 131-144.
- 45/ Norman, 1971.
- 46/ The point is made by Helleiner, 1975, p. 45. One of the better studies is Shapiro, 1974.

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