EXPERIENCES WITH
AGRICULTURAL DEVELOPMENT IN TROPICAL AFRICA

VOLUME I

THE SYNTHESIS
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AGRICULTURAL DEVELOPMENT
IN TROPICAL AFRICA

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THE SYNTHESIS

by

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FOREWORD

This study was undertaken under the auspices of the International Bank for Reconstruction and Development. It was directed by John C. de Wilde, formerly Acting Director of the Economic Staff of the Bank, who is also its principal author. The following experts participated in the study:

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The views expressed in this study reflect broadly a consensus of the participants. However, the conclusions and recommendations are not necessarily endorsed by the Bank.
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**Conversion Table**

**Currency**

<table>
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<td>1 East African shilling</td>
<td>= 1 U.K. shilling</td>
</tr>
<tr>
<td>1 shilling</td>
<td>= 14 U.S. cents</td>
</tr>
<tr>
<td>1 shilling</td>
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<tr>
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<tr>
<td>100 CFA francs</td>
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<tr>
<td>100 CFA francs</td>
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<td>1 square mile</td>
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</tr>
<tr>
<td>100 persons per square km.</td>
<td>= 259 persons per square mile</td>
</tr>
<tr>
<td>100 shillings per acre</td>
<td>= 8,540 CFA francs per hectare</td>
</tr>
<tr>
<td>10,000 CFA francs per hectare</td>
<td>= 117 shillings per acre</td>
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EXPERIENCES WITH
AGRICULTURAL DEVELOPMENT IN TROPICAL AFRICA

VOLUME I

THE SYNTHESIS
CHAPTER ONE

INTRODUCTION: DEFINITION OF THE STUDY

Objectives

This study of agricultural experiences in tropical Africa was inspired by three considerations. The first is that agriculture is destined to remain for a long time the basis of the economy and therefore an important object of government planning and policy-making. The second is that in virtually all the less developed countries the development of agriculture has shown itself to be peculiarly difficult and has tended to lag behind that of other sectors of the economy. The third and perhaps most critical consideration is the conviction that a proper analysis of selected experiences with agricultural development can provide important guidelines for the future.

The first of these considerations need not be elaborated. In emphasizing agriculture we have no wish to de-emphasize the importance of developing industry. That the two must go hand in hand in some measure goes without saying, although it is not our task here to examine the essentials of a balanced development of the two. We must recognize, however, that probably 90 percent of the population of tropical Africa is still rural, that agriculture and livestock husbandry employ about 80 percent of the people and are the major earners of foreign exchange. Experience with industrial development in most of the less developed world would indicate that even on the most sanguine assumptions about the rate of industrial growth it may well be long before industry absorbs all of the increase in population quite apart from any significant proportion of those now obtaining their livelihood from the land. The profitable employment of people on the land will therefore need to remain a central preoccupation of government policy.

The comparative neglect of agriculture by governments of the less developed countries appears to be due less to a lack of interest than to a shrinking from the complexity and difficulty of the task. It is much easier to build ports, railways, roads, and power stations;
and the talent necessary for either construction or operation can be imported if it is not available at home. It is even comparatively easy to build and operate factories, for production takes place in a narrowly confined and closely controlled environment under a single management and under conditions where the machine or process determines at least partly the pace.\(^1\) In agriculture, however, the conditions of production are not easily controlled. Often the vagaries of climate frustrate the best efforts of farmers and government. In each country there are hundreds of thousands, or often millions, of independent producers or "decision-makers" who may vary widely in their capacity and their responses to various outside stimuli and government policies. Their activities cannot be directed but only influenced. Frequently they have evolved some system of farming or land use which is in rough balance with their natural milieu and makes reasonably good use of the knowledge and the factors of production at their command, but which at the same time is difficult to transform without disturbing its equilibrium. New crops are sometimes introduced but generally as a graft on a system of production which remains otherwise unaltered. Often separate new practices cannot be adopted without entailing others.\(^2\) Improved varieties usually require higher standards of cultivation and other inputs such as fertilizer, manure, and insecticides for the realization of their full potential. Early planting and row planting often necessitate the introduction of new implements. The proper organization of the many government services concerned with agriculture is also an extraordinarily difficult task. The services involved are not only those dealing with agriculture and livestock, but also those occupied with forestry, public works, health, education, community development, credit, and cooperatives, as well as general administration. The coordination of all these separate services not only at the national and regional, but above all at the farm level is often one of the major problems.

**Usefulness of past experience**

The thesis that an understanding of past experience can provide lessons for future development should not be accepted without quali-

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\(^1\) We are not suggesting, of course, that industrial production, particularly at competitive costs, is at all easy in an absolute sense.

Introduction

Within tropical Africa there is such a diversity in the human and natural factors affecting production that experiences are seldom integrally transferable. Even if only experiences from the more recent past are studied, conditions that had an important bearing on their outcome may have altered. The structure, traditions, and values of rural society are all changing, in some cases rather rapidly. With the advent of political independence, some of the obstacles to agricultural development have disappeared but others have arisen, thus affecting to some degree the current relevance of experience during the colonial period.

Yet even though the essential conditions of any one experience can never be exactly duplicated, the past can still provide much valuable guidance in the determination of development schemes, programs, and policies in the future. A knowledge of the past successes and failures can be useful in at least three ways:

1. **In providing a check list of all the potentially relevant factors that need to be considered before deciding whether to embark on a new agricultural scheme or program.** In agriculture more than any other sector it is difficult to anticipate what effect proposed government measures will have on production, both in its entirety and in its incidence over time. Costs and benefits cannot be quantified with assurance, especially owing to uncertainties surrounding the responses of the farmers. A knowledge of the critical determinants of such responses under various sets of conditions can greatly assist in assessing the prospects for success and thus minimize uncertainties about the results. Past experience can raise a whole series of warning signals about all the factors—physical, economic, and social—that must be carefully considered in any appraisals of development possibilities.

2. **In helping to determine how specific aspects or parts of new schemes or programs might be handled.** While the blend of the ingredients of agricultural development is never quite the same in any two cases, this does not mean that the quality of the individual ingredients cannot be improved by judicious application of the lessons of the past. Parts of both successful and unsuccessful experiences can and do yield useful suggestions on an appropriate handling of similar parts of new schemes—for example, on the conditions and methods essential to effective changes in land tenure; appropriate methods of organizing extension work and its approach to the cultivators; the appropriate role and administration of agricultural credit; the ways of fitting new practices and crops into established farming patterns; the organization of supplies and requisites of production for farmers, etc.

3. **In indicating directions or types of development activities which ought to receive increased emphasis in the future both by governments and by agencies**
or countries providing aid. Examination of the records and results of schemes or programs can bring to light a "pattern" of failures or shortcomings. Repeated recurrence of the same failings suggests either that certain problems are intractable or that development efforts should be oriented in such a way as to overcome them. If experience shows that lack of certain types of training and education, whether of farmers or of those who deal with them, has been a consistent cause of failure, this obviously points to more emphasis on this problem in the future. Similarly, if ignorance of critically important factors has often prejudiced success in the past, the need for particular types of studies or investigations presumably becomes quite necessary. Thus, one of the objectives of an analysis of experiences is to identify the bottlenecks to rapid development which must, if at all feasible, be widened.

**Scope of the study**

From the outset we decided to confine our study to African agriculture within the tropics. Thus we excluded all of North Africa where ecological and social conditions were markedly different from those of tropical Africa. Similarly, we gave no consideration to South Africa where agriculture is predominantly temperate and subtropical, and has been developed primarily by white farmers. We also excluded from our frame of reference plantation agriculture and the experiences of white settlers in East and Central Africa.

The selection of experiences for study posed difficult problems. We wanted a sample that was reasonably representative of (1) major variations in ecological conditions, (2) different stages in the evolution of rural society from a largely tradition-bound and subsistence-oriented society to a more "open," market-oriented society, (3) differences in population pressure on land, and (4) various methods of approach to agricultural development.

*Ecological conditions*—Types of vegetation and soil, range in temperature, amount, distribution, and retention of rainfall constitute fundamentally important natural limitations or constraints on agriculture. They determine the types of crops, the degree of urgency in timing of agricultural operations, the extent of risk involved in

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3 For a brief description of ecological zones in Africa, see [FAO Africa Survey—Report on the Possibilities of African Rural Development in Relation to Economic and Social Growth](Rome, 1962). The scrubby savanna of the Sahelian zone, with a rainfall of 10 to 24 inches (250 to 600 mm.) confined to a period of 3 to 4 months, is primarily suitable, unless irrigated, for livestock (principally goats and sheep) and to some extent for the cultivation of millet and sorghum. The savanna country of the Sudanian zone, with a rainfall of 24 to 49 inches (600 to 1,250 mm.) over 4 to 6 months, supports a wider range of natural vegetation and crops, including sorghum, millet, maize, groundnuts and yams; its livestock includes...
agriculture and in improvements of agriculture, the comparative needs for water and soil conservation, and the opportunities for, and relative emphasis on, livestock-keeping in conjunction with agriculture.

A proper range of societies had to be included, above all, in order to study human responses to measures of agricultural improvement and development. Societies with varying aspirations as conditioned by degree of education, outside contacts and other factors inevitably differ greatly in their response.

Apart from the structure and standard of values of society, the degree of pressure of population and livestock on land was assumed to be an important variable in determining response to agricultural change and particularly to efforts at intensifying methods of production. Obviously population density per unit of area was not particularly helpful in applying this criterion of selection, for it ignores variations in land use and the great differences in the agricultural potential of land. Suffice it to say that in the light of the relationship of population to ecological conditions we included in our sample areas of high, medium, and low population pressure.

A wide representation of different approaches to agricultural development, both to the constituent elements in this development and their relationships to each other and the whole, was particularly important to the selection of our sample. First of all, we were intent on examining attempts to improve and innovate in established farming areas, on the one hand, and to institute new crops and new systems of farming on newly settled dry-farming or irrigated areas, on the other. Secondly, we wanted to study a variety of experiences with the introduction of both tractor-drawn and animal-drawn implements and with the association of crop and animal husbandry. In this connection it should be pointed out that we did not deal with the problems of purely pastoral peoples. Thirdly, we sought to deal with different methods of introducing and improving both annual and tree crops. Finally, we selected approaches illustrating various methods of organizing and handling government services for agriculture including extension and research, supplies, land tenure, credit, cooperative action, marketing, training, and education.

more cattle in relation to small stock. The Guinean zone, with a rainfall of 49 to 70 inches (1,250 to 1,800 mm.) spread over 6 to 9 months, is characterized by a much more lush vegetation, produces about the same range of crops as the Sudanian though at less risk, but is often inimical to cattle owing to tsetse fly infestation of the bush. The Guinean equatorial (tropical rain forest) zone, with a rainfall of 70 inches and above (over 1,800 mm.) features primarily bananas, plantains, maize, yams, and taro as food crops, and such tree crops as oil palm, cocoa, rubber, and robusta coffee.
AGRICULTURAL DEVELOPMENT IN TROPICAL AFRICA

The areas chosen for study

In the light of these criteria we chose the following thirteen areas for field investigation:

1. Five areas within Kenya which we examined primarily within the framework of the objectives and policies originally laid down in the so-called Swynnerton Plan. These areas include:

   a. **Nyeri District**, which for the most part has a temperate climate, well distributed rainfall, but is extremely heavily populated. This area is inhabited by the Kikuyu, who have long been subject to modernizing influences, and are on the whole the most advanced African farmers of Kenya. Here freehold land tenure has been completely introduced and considerable success has been achieved with arabica coffee, tea, pyrethrum, and, what is for Africa most unusual, dairying.

   b. **Elgeyo-Marakwet District**, which includes a succession of distinct ecological zones ranging from the semi-arid Rift Valley floor to the well-watered uplands. Its Kalenjin-speaking Elgeyo and Marakwet peoples have shown markedly different rates of progress. The favorably situated and less crowded upland areas have witnessed, in quite recent times, the adoption of modern dairying, sheep-raising, and wheat-farming, and individual enclosure of arable and grazing land.

   c. **Baringo District**, which is a relatively isolated area with a severely restricted amount of good agricultural land and much larger amounts of rather dry and poor wooded savanna. The principal problem of this district, inhabited predominately by the Nilo-Hamitic Tugen, has been the increasing pressure of people and livestock on available resources.

   d. **Central Nyanza District**, which includes areas ranging from medium to low agricultural potential and suffers, like Baringo, from rather severe population and livestock pressures. Its people, the Nilotic Luo, have long resisted changes in land tenure, agricultural methods, and livestock improvement. In the past the high labor migration rate and the possibilities of agricultural development have apparently had important repercussions on each other.

   e. **Machakos District**, which is in many respects similar to Central Nyanza, both in its potentialities and its problems. Like Central Nyanza, the district and its people—the Kamba—have had a reputation of being “difficult” in the eyes of government officers concerned with development.

In addition, we took the opportunity to examine the Mwea irrigation scheme in Kirinyaga District, which is generally considered a conspicuously successful project, and the methods employed in settling erstwhile European farms, particularly in terms of the relationships
Introduction

of these settlement schemes to the problems in long-established African farming areas.

2. Two areas in Uganda, namely:

   a. *Kigezi District*, which for the most part consists of a rather isolated, densely populated mountainous area. There efforts have long been made to assist the Kiga people both in adapting their methods of land use to growing population pressure, and in settling on land still available in the less crowded portions of this district and other districts.

   b. *The slopes of Mount Elgon*, which are inhabited predominantly by the Bantu-speaking Gisu, and like the mountain areas of Kigezi, experience considerable population pressure. This area provides an interesting case study of both the problems and potentialities of a single cash crop—arabica coffee. Development has been troubled at various times by resistance to efforts to improve standards of cultivation and difficulties encountered in the organization and operation of coffee cooperatives.

3. One area in Tanzania, namely *Sukumaland*, an extensive plateau comprising in large part a cultivation steppe, stretching southward from Lake Victoria and enjoying a climate marked by rather erratic rainfall and recurring droughts. Inhabited by the Sukuma, who have long been rather isolated from Western contacts and influences, the area has witnessed many largely abortive attempts to alter the extensive methods of crop and animal husbandry which have been the despair of agricultural and livestock experts. At the same time, the region has seen a remarkable growth of cotton production and of cooperative organization for handling this crop.

4. Two areas in Mali:

   a. *The Office du Niger*, an autonomously administered irrigation project where production of cotton and rice has been developed with settlers from the dry farming regions of Mali and Upper Volta. Although somewhat similar to Sudan’s Gezira scheme, it has been plagued by many problems of planning and operation which have prevented it from fulfilling original expectations. The project has had a checkered history involving experimentation with different cropping patterns, varying degrees of mechanization and repeated efforts at intensification in the hope of achieving production levels that would meet overhead and capital as well as current operating costs.

   b. *An extensive dry-farming area extending from the border of the Sahelian zone into the Sudanian zone*, in which a French organization has been responsible for the promotion of cotton production by African farmers, and more recently for all agricultural extension work under contract with the Government of Mali. It provides
an interesting instance of the introduction of a cash crop in a system of traditional farming, and also of the operation and effectiveness of an autonomous organization which not only advises farmers but provides them with the means of production and, for cotton, also with the marketing facilities.

5. The central region of Upper Volta, characterized by generally poor soils and rather unreliable rainfall and inhabited by the Mossi whose social structure is still strongly traditional and who have long supplemented their meagre income from agriculture by migratory labor and, to a lesser extent, by other nonagricultural pursuits. Here another French organization has been directing for some years an extension service which has focused, in the first instance, on the production of a more ample and secure food supply by expanding the area under cultivation through the introduction of animal-drawn implements and by encouraging the use of fertilizers.

6. The rather remote Bokoro region in the Chad where, as in the Mossi area, natural conditions—low and irregular rainfall—make remunerative agriculture very difficult, and where still another French organization has been charged with extension work which is directed primarily toward the adoption of animal-drawn implements and organization of farmers’ cooperatives for the purpose of buying such implements and also of selling farm produce and purchasing key consumer goods.

7. The region around Bouaké in the central part of the Ivory Coast which is a transitional area between the Sudanian and Guinean zones has a rather favorable potential for agricultural development and is inhabited by a people—the Baoulés—who have progressed to some extent beyond a subsistence economy. Here a foreign company with an international staff has been working on a modest scale in villages to increase receptivity to change by training staff to assess the problems of the villagers, and encouraging the latter to formulate their needs and to pioneer improvements under their own leadership with such technical assistance from the outside as may be necessary. This affords an example of an approach known in the French-speaking areas of Africa as “animation rurale” which emphasizes the need to awaken local initiative and responsibility and, though concentrating primarily on agriculture, is also concerned with some of the broader problems of rural improvement.

While we largely concentrated our field work on the areas and schemes listed above, brief visits were made to Rwanda and Burundi. There we studied the methods and results achieved in introducing
Introduction

cash crops among peoples with still relatively low income aspirations and examined the degree of success with the establishment of "paysannats" which sought to provide relief for certain conditions of overpopulation and simultaneously to initiate new systems of land use. We also visited Malawi, where we inquired into the reasons for the virtual failure and unpopularity of certain village land reorganization and improvement schemes and the "master farmer" approach to extension work. In addition we went to some areas of Tanzania where we were interested in some development projects which the Tanganyika Agricultural Corporation had been carrying on as an aftermath of the ill-fated and well-publicized "groundnuts scheme." Moreover, some of the participants in this study were able to draw on previous field experience.

The method of study

Basically our task was to appraise the results achieved by these programs and schemes and to identify the factors which were the more important causes of success or failure. The criterion of success used was the extent to which stated or implied objectives were achieved. Our appraisals did not involve a quantitative assessment in retrospect of the costs and benefits in each case. This is not because we deprecate in any sense the importance of seeking to estimate such costs and benefits in quantitative terms, but because the necessary data were lacking, incomplete, or unreliable, or because an inordinate amount of time would have been required to marshal or analyze the relevant data. In still other cases the projects or programs were still under way, so that any final assessment could not yet be undertaken. It should be stressed, however, that we were keenly aware of the need for an economic justification of development projects or programs, and that wherever possible we have assessed the economic merits of particular approaches.

In approaching our task we did not attempt to make a profound study of every case. Our emphasis was, rather, on a rapid and comparative survey of a large number of experiences for the purpose of highlighting differences and similarities in approach. The knowledge derived from our field work was substantially supplemented by information on many other experiences derived from an extensive reading of the literature, as well as consultations with numerous experts concerned with agricultural development.

Our analysis starts from the conviction that efforts to develop agriculture are likely to be successful only if they are:

1. Suitable to the natural environment. This means that they must be
properly adjusted to ecological conditions—the characteristics of soils and climate, including the range of temperature and rainfall, and the pattern and reliability of the rainfall. Not only is it necessary to possess adequate knowledge of ecology and the whole physical milieu, but research and experimentation must have devised approaches to the development of agriculture adapted to the physical variations in natural conditions.

2. Feasible in terms of the availability of all the "inputs" essential to the achievement of the objectives. There must be enough labor as supplemented by tractive power and implements, sufficient land, and any other requisites of production such as water, fertilizers, and insecticides, and whatever guidance, instruction, or direction of the cultivators as may be needed.

3. Appealing in the sense that the economic return is sufficient and that farmers consider themselves adequately compensated in the light of their felt wants and their sense of values. This concerns, above all, the human factors of production, their motivations and responses to various types of incentives, their attitudes toward work, and their receptivity to change in general.

4. Accompanied by institutions and policies which can provide the necessary services, supplies, and facilities for both production and marketing, and any other necessary stimulus to incentives through appropriate pricing, land reform, or other measures. The satisfaction of this requirement depends, of course, primarily on the capacity of the government.

While we have not ignored the technical factors or technical limitations, our principal preoccupation has been with the response of African farmers, individually and collectively, to efforts to raise their output. For this reason this study was carried out with the help not only of an agriculturist, but also of economists and a social anthropologist. The representatives of all three disciplines focused their attention primarily on the farmers and their reaction to innovation. The agriculturist concentrated on determining whether the changes in crop and animal husbandry which farmers were expected to make were indeed relevant to the conditions under which the farmer was working and showed an adequate appreciation of the degree of rationale in already established patterns of land use. The economist was interested in finding out to what extent particular measures or programs apparently struck the farmers as being economic from the "enterprise" standpoint. And the social anthropologist provided the insights into the society where development was being attempted—into the society's organization, leadership structure, system of values and motivations, attitudes toward land, the respec-
Introduction

tive roles of men and women, and the speed and direction in which it was changing under the impact of "modernizing" influences.

In the light of this basic orientation, most of our field work was devoted to interviewing farmers and those members of government services who are in direct contact with farmers. We talked individually or collectively to well over 500 farmers at considerable length and went over many of their farms. Most of these farmers, chosen by the agricultural staffs, were "progressive" in the sense that they had adopted some new practices or methods. We sought to correct this bias by including at least some "bad" farmers; and we also found that many of the progressive farmers, who usually had followed only part of the advice tendered them, were frequently able to throw a revealing light on the factors that led them to adopt some and reject other changes. Moreover, interviewing a disproportionately large number of "progressive" farmers enabled us to determine more clearly whether these shared some identifiable characteristics.

We used many different methods of checking and complementing our own observations in the field. In each case we interviewed many people who had been concerned with planning and carrying out the particular agricultural development program or scheme; and we consulted such farm surveys, village studies, and other relevant documentation as were available on each of the areas.

An investigation such as we have undertaken obviously cannot produce a prescription or series of prescriptions for the development of agriculture in particular areas. But we can indicate the considerations important in a proper approach to the problems that are involved, as well as the merits of various ways of handling particular aspects of development.

Organization of the report

The programs or schemes on which we have done some field work have been written up as case studies which are appended to this report. The case studies have the advantage of treating, in a more or less integrated fashion, all the factors relevant to development in the particular instance. The main report does not seek to summarize cases, largely because such summaries would be too schematic or

4 The Uganda case studies, which were undertaken by a special team under the direction of Dr. D. G. R. Belshaw of Makerere University College, were not completed in time for publication. The conclusions of the field work have, however, been taken into account in the Synthesis.
would simply reproduce the conclusions already incorporated in
each case study. Instead, we shall attempt to draw the lessons of
experience, seeking to highlight deficiencies in the past approaches,
and to elaborate the requirements of successful agricultural de-
velopment.

We have not attempted to use any particular classification of agri-
cultural schemes or of approaches to development as a framework
for our analysis. Many of the experiences with development that
we considered do not, in fact, readily fit into any classification
scheme. This is particularly true of more general programs of de-
velopment. Moreover, while each type of scheme may have some
peculiar problems, a considerable number of problems are common
to all.

We have tried to center our analysis as far as possible on the
essentials of agricultural development, and at the same time to keep
to the forefront constantly the complex interrelationships of all the
relevant factors. We first deal briefly with some of the salient char-
acteristics of tropical African agriculture in order to provide the
necessary background. We then proceed with a discussion of two
areas important to development in which experience indicates
that knowledge is deficient or the importance of adequate knowl-
edge is insufficiently appreciated. The first of these areas relates to
deficiencies in knowledge of the physical milieu and in the "solutions"
devised by research for different types of ecological conditions.
The second area concerns the need and the failure to understand
fully the human agents of production and the society of which they
are part and which conditions their behavior. We then turn to a
discussion of particular aspects of agricultural development which
have impressed us as being important. The first of these is the factor
of labor and the broader problem of population pressure on land
which has to a large extent determined the degree of success achieved
by efforts to intensify agriculture. This leads naturally to a con-
sideration of the related problems of draft power, tools, and imple-
ments which seem to us to have been relatively neglected. The third
problem area examined is land tenure, which we construe broadly
to include the relevance to development of not only various ways of
"holding" or "owning" land, but also different forms of utilizing
land, ranging from the individual to the collective. This is followed
by an analysis of various aspects of agricultural extension, and by
briefer observations on agricultural credit, marketing, and co-
operatives. Our conclusions and recommendations as they have
emerged from the analysis of different experiences are then drawn
together in the last chapter.
CHAPTER TWO

PRINCIPAL FEATURES OF AFRICAN AGRICULTURE

This chapter describes briefly the more important features of agriculture in tropical Africa to which reference is constantly made in this report.¹ Such a background description cannot pretend to be exhaustive or avoid some degree of generalization to which exception could well be taken. It applies basically to the more or less traditional forms of agriculture which are still predominant in that part of the world rather than to the relatively limited areas where agriculture has evolved significantly in the direction of new patterns of production. And it is addressed not to the expert but to the general reader who is interested in agricultural development.

Poverty of the habitat

It is a widespread popular fallacy that natural conditions in tropical Africa are very favorable to agriculture. The exuberant growth of natural vegetation and the rapid regeneration of bush or forest following clearing tend to conceal the fact that soils are for the most part very poor. Over large parts of Africa rainfall is either so marginal or erratic as to make farming and even herding hazardous, or so intense as to produce leaching and deterioration of soil structure, with consequent loss of nutrients and increase in erosion. In the large areas where there are pronounced rainy and dry seasons and wide ranges in temperatures, the high temperatures and accompanying high rate of evapo-transpiration during the dry season is often accentuated by the hot dry winds from nearby deserts, such as the famed harmattan blowing from the Sahara.

African soils are in large part deficient in the characteristics of

¹ The reader acquainted with the general characteristics of tropical African agriculture is advised to proceed to Chapter 3.
structure, texture, and chemical composition which together are the principal determinants of fertility. The basic poverty of the soils is due principally to the poor parent material or rock from which they are derived and the low content of organic material. Except for limited areas with soils of volcanic origin, such as those around Mt. Cameroun in West Africa and in the highlands of East Africa and Rwanda and Burundi, African soils are generally derived from old, acid parent rock which is poor in calcium and nutrients. The average organic content of African soils is only 0.2 percent to 0.5 percent, as compared with about 2 percent for the cultivated soils of Europe. This is a particularly crucial deficiency because organic matter when converted into humus by the activity of micro-organisms in the soil greatly enhances the soil's capacity for retaining moisture, storing the nutrients required by plants and resisting erosion. Moreover, natural conditions are often unfavorable to optimum activity by soil micro-organisms, in some cases producing excessively rapid oxidation of the stock of organic matter under conditions of a porous, well-aerated soil, and warm but not excessive soil temperatures and, in a few cases, bringing bacterial activity virtually to a halt under conditions of high soil temperature and excess acidity.

The precarious equilibrium in African soils is easily upset after the natural vegetation is cleared and cultivation begins. Oxidation produced by excessive cultivation may unduly accelerate the activity of micro-organisms. The exposure of the bare soil to the violent rains characteristic of tropical Africa can bring about a rapid deterioration of structure by dispersing the finer aggregates to low soil horizons or washing them away. Erosion is often extremely severe under these conditions. Heavy and continuing rains can cause rapid

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2 "Structure" refers to the degree of aggregation of the ultimate soil particles into water-stable compound particles or "crumbs" which permit the proper circulation of water and air essential to the growth of plants and the activity of micro-organisms. "Texture" is reflected in the size and distribution of the ultimate particles such as gravel, sand, and such colloidal elements as clay and humus, which, particularly when coagulated in a clay-humus complex under the influence of calcium carbonate, help stabilize the soil and greatly enhance its capacity for retaining water. The "chemical composition" reveals its richness in mineral nutrients as derived from the chemical and physical breakdown of the soil's parent material and the replenishment of nutrients by natural or artificial means.

3 In the Casamance area of Senegal it has been estimated that the oxidation taking place through two successive seasons of groundnuts cultivation causes a loss of 30 percent of the organic matter and 60 percent of the colloidal humus in the soil. See R. Fauck, "Premières observations sur les relations entre les engrais verts et la fumure minérale en Casamance," Compte rendu de la 2ème conférence interafricaine des sols (Leopoldville, 1954).

4 In Guinea it has been shown that on slightly ferrallitic soils with a 6 percent slope and a rainfall of 1,490 mm. (59 inches) the annual erosion loss per hectare
deterioration of soil structure and loss of nutrients. Finally, con-
tinuous cropping inevitably takes nutrients from the soil at a rate
greater than their natural reconstitution, and also encourages the
development of more resistant weeds which give greater competition
to cultivated plants.

The extent of actual or potential deterioration in fertility depends
on the type of soil, vegetation, relief, and climate. In regions where
heavy rainfall is succeeded by a hot dry season, silicates tend to be
broken down into iron and aluminum hydroxides and brought by
evaporation to or near the surface where they form a hard pan or
cuirass which is sterile and quickly exposed to erosion. This process,
which is sometimes called “bowalization,” often takes place in the
South Sudanian and Sudano-Guinean zones. Where rainfall is not
high, the soil deep and the slopes gentle, such as in Sukumaland,
the deterioration may be quite slow. In general, there is the least
tendency toward degradation in uplands which have a well-
distributed rainfall and are protected against runoff, and in the
equatorial forest zones, where a combination of natural forest and
tree crops protects the soil, organic matter is naturally renewed to
some degree and deep-rooting trees manage to cope with the results
of leaching.

The consequences of low soil fertility are aggravated for large
areas by the erratic nature of the rainfall which may deprive live-
stock of grazing, wither crops in the field, and thwart the absorption
of nutrients supplied in the form of artificial fertilizers or manure.
To this must be added the prevalence of pests and diseases which
frequently inflict great damage. Grain-eating birds, particularly the
quelea, and, in some areas, rodents and game, are a frequent menace
to food supply. Bush harbors the tsetse flies that may induce sleeping
sickness in man or beast and the ticks which carry livestock diseases.
Locusts, army worm, and other pests also do untold damage at times.
Stagnant and slow-moving waters encourage the anopheles mosquito
and a species of snail which are the vectors for the debilitating
diseases of malaria and bilharzia respectively.

Descriptions such as the above must not be interpreted as uni-
versally applicable. There is a great heterogeneity of soils, climates,

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was only 2.7 tons when the soil was under natural vegetation, 4.07 tons when
under a cereal like fonio which covered the soil well, and as much as 18.88 tons
when the soil was bare (or nearly by the same quantity when the soil supported
well-weeded maize). See F. Ducain and R. Fauck, “Mesures d’érosion et de
ruissellement en moyenne Guinée,” *Compte rendu de la 3ème conférence interafricaine
des sols* (Dalaba, 1959).

5 Pierre Viguier, *L’Afrique de l’ouest vue par un agriculteur* (Paris, La Maison
and other natural conditions in tropical Africa, and it is always important to keep this in mind. The principal point which must be made is that over large areas the natural milieu is not particularly conducive to successful and remunerative crop and animal husbandry. In view of the "constraints" of an unfavorable natural environment the African peasant often can hardly be held responsible for the poor productivity of his land and his labor. The fatalism and distrust of innovation that he may display under such conditions are less causes of underdevelopment than consequences of his inability to control his environment. "When an unforeseen drought or an adverse storm destroys impartially the best kept and the worst kept fields, good farmers have some reason for becoming discouraged."  

African adaptation to natural environment

As the result of experience and observation over generations, the African cultivator has learned in large measure to adapt his methods of cultivation and pattern of cropping to the limitations of his environment. The widely prevailing systems of shifting cultivation whereby land, after some years of cultivation, reverts to more or less lengthy bush fallow recognize the need for natural restoration of soil fertility. Under shifting cultivation land is cleared by lopping off the bush and smaller trees, and burning the vegetation. In some cases, as in the so-called Chitemene system of Zambia, the cleared brush wood is concentrated and burnt, and millet subsequently planted in the ashes which retain all the mineral content of the vegetation except for the nitrogen and sulphur; or, where the land has been under predominately grass fallow, the grass may be turned into the center of mounds to rot and contribute to the growth of plants subsequently sown around the edges of the mound. The incomplete clearance of bush and trees, due apparently less to design than to lack of adequate implements, facilitates the rapid regeneration of growth when land is fallowed.

While African history and legend record many treks of whole tribes or clans in search of new land after the old had been exhausted, shifting cultivation is now only rarely the same as nomadic agriculture. Partly under administrative pressure, farmers have be-
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come virtually all sedentary and they have developed rights in holdings which extend to the area in bush fallow as well as that under cultivation. At the same time limited areas of more or less permanent and continuous cultivation have developed not only in the more fertile and overcrowded areas, but also, as in many parts of West Africa, in and around the villages. Near such villages, for example, there are special areas where additions of household waste and of limited quantities of manure or the confined grazing of livestock may facilitate more continuous cultivation. The land farther from the village is then still subjected to shifting cultivation, and when even that becomes scarce yet more inaccessible land may be put to crops through the establishment of cultivation camps or temporary villages which may in time become permanent.

Although the extensive type of agriculture implied in this method of shifting cultivation has in the past often been thoughtlessly condemned, it is now generally recognized that “under the earlier and in many areas the still existing circumstances of relatively mild population pressure, the local socio-economic organization and the availability of land, shifting cultivation has been and still is widely suited ecologically and socio-economically to the simple needs of man and the potentialities of the environment”; and also that “its extensive and practicable replacement by some more satisfactory procedure—where increased human pressure and reduced availability of land dictate—is by no means easy in the light of our present knowledge.”

The earlier assumptions that the African husbandman was ignorant and recklessly bent on destroying his natural habitat have now been largely discarded. The African generally has his own systems of soil classification, usually according to the association of soils


9 The discovery that farmers in less developed countries are not altogether unsophisticated still comes, however, as a surprise to many. Thus a group of experts visiting Turkey, after noting that the Turkish farmer often appeared to have good reason for not following extension advice, expressed its puzzlement in these words: “The reasons why he did things the way he did often made so much sense that the interviewers were sometimes at a loss as to who was right and who was wrong, the agricultural extension worker or the farmer.” See Central Treaty Organization, Travelling Seminar for Increased Agricultural Production (Report of a Regional Tour, April 7–May 30, 1962, Ankara, Office of the U.S. Coordinator for Cento Affairs, 1962).

10 The soil classification still used in the Office du Niger, though in some respects inadequate, is basically derived from indigenous sources. Dr. Phillip Porter, in a paper entitled “Suk Views on Suk Environments” read at the September 1963 meeting of the Association of American Geographers held at Denver, Colorado reports that the Suk in Kenya recognize twelve distinct soil types, each with different uses.
and vegetation. He has shown an ability to find and grow the right kinds of crops for various micro-climatic conditions. Under appropriate conditions he will make ridges and mounds to concentrate around the plant the more fertile top soil and facilitate its proper drainage. Where the pressure of population on land has greatly increased, he has in many areas demonstrated, as we shall show later in greater detail, his capacity for shifting gradually to more intensive methods of cultivation. A student of African agricultural methods has written: "He [the African farmer] can rate the fertility of a piece of land and its suitability for one or other of his crops by the vegetation which covers it and by the physical characteristics of the soil; and he can assess the ‘staying-power’ of a soil, the number of seasons for which it can be cropped with satisfactory results, and the number of seasons for which it must be rested before such results can be obtained again. His indicator of initial fertility is the climax vegetation and his index of returning fertility is the succession of vegetational phases that follows cultivation. In many cases his knowledge is precise and remarkably complete." 11 The same authority points to similar knowledge of environment by pastoralists. These usually know and identify by name the various grasses, recognize ecological associations, and can assess the value and stock-carrying capacity of various types of pastures at different times of the year.

Another characteristic of African agriculture which seeks to make the most of the potentialities of the environment is the practice of mixed cropping or the growing of a number of crops together on the same piece of land. This practice, though it appears to result in a rather chaotic, higgledy-piggledy type of cultivation, has certain advantages. By planting a succession of crops with varying planting times, rooting habits and maturities, the cultivator may make better use of his or her time, permit plants to tap the nutrients in various soil layers more effectively, distribute the risks due to vagaries of climate or incidence of pests and diseases, assure a more regular food supply and gradually, as the season progresses, cover the soil so well with vegetation that there is more effective protection against the effect of sun and rain and comparatively little need for the time-consuming job of weeding. Moreover, as long as only “unimproved” varieties of crops are available or are used, the total yield from a given area may well be higher than when a single crop is planted in pure stand.

While Africans have this undoubted capacity to adapt their

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methods of land use to the limitations of their natural environment, they often fail to make the best use of the land. Their methods have tended not to preserve, let alone build up, soil fertility, but rather to arrest the rate of deterioration. Their adaptation to changes in their environment is often delayed, resulting in the stabilization of output at a low level. Their limited horizon often blinds them to the long-term consequences of some of their practices, and particularly to the need for timely measures to check soil erosion and degradation which in many parts of Africa have assumed serious proportions. The method they use of classifying soils by the types of vegetation supported does not give them a knowledge of soil structure sufficient to gauge the consequences of upsetting the balance between soil and vegetation, or of introducing new crops.

Other features

Population distribution

Although tropical Africa has long been characterized by scattered areas of rather high population densities, the greater part has been populated at a rate which has made it possible to pursue the extensive type of shifting cultivation with fairly long bush fallow that we have described. But population pressure is increasing almost everywhere with high densities no longer restricted to particularly fertile areas or comparatively remote areas in which people had sought refuge from tribal warfare. A large part of past efforts at agricultural development in Africa has been directed toward either remedying this "maldistribution" of population to resources, or accelerating the shift to more intensive methods of production to accommodate the population pressure. Even with effective population control in due course, future efforts will have to pay increasing attention to intensification simply because available lands will have been occupied.

The emphasis on subsistence farming

A prominent characteristic of African agriculture is its continued emphasis on subsistence farming. It is probable that as much as 70 percent of the land and 60 percent of the labor are devoted to sub-

12 In the forest zone the traditional bush fallow may be compatible on the average with a population density of 20 per square kilometer (or about 50 per square mile). When soils are fertile (such as in the case of volcanic soils) and rain abundant and well distributed, the critical density may be around 40-50 per square kilometer (ca. 105-130 per square mile), but where rainfall is scant and soils are poor the possible density is likely to be only about 10-15 (25-40 per square mile).
sistence production. Even where cash cropping has been introduced on a considerable scale, farmers still tend to insist on food self-sufficiency. The principal determinant of the amount of land cropped in most of Africa is the food requirement of the farm family, and in many cases the limited availability of manpower or implements permits the cultivation of relatively little land for cash crops. Thus there is as yet little specialization of production or exchange of products among farmers. The indigenous market for foodstuff tends to be limited and uncertain. Since the degree of urbanization, though growing, is still low, commercial production is primarily oriented toward external markets.

Probably the most important factor militating in favor of continued food self-sufficiency on the farm is security. Inability to produce food sufficient for one's own family and to meet eventual obligations to help out kin is still regarded as a source of shame in most parts of Africa. The aim is to produce, if at all possible, somewhat more than is needed so that, taking the bad years with the good, basic food requirements can at all times be met. This means, incidentally, that the supply of marketable foodstuffs, and, therefore, prices, fluctuate widely from year to year. The remoteness of many areas from markets, poor and costly communications, and fluctuating prices, all combine to reinforce this disinclination to be dependent on the market for essential food supplies. The fact that the man in much of Africa keeps the income from cash crops usually causes the woman, who has responsibility for feeding the family, to insist all the more tenaciously on producing all the family's food needs.

This continuation of subsistence farming contributes to qualitative limitations of the diet, for the farm family can eat only the food it can grow in the particular climate. Subsistence often entails the comparatively inefficient use of land for production of food when such land could much better be devoted to cash crops. In a sense the African farmers are caught in a vicious circle, for the inadequacies of the market prevent them from raising their output through specialization, while their own desire for security inhibits the growth of the market.

This limited commercialization of farming extends also to land, one of the principal factors of production. Except in still rather limited areas, land is not bought and sold in the market place. Land is primarily a source of security and insurance of basic livelihood. Even those who abandon it for a time to seek their fortunes elsewhere keep a stake in the land and generally expect sooner or later to return to it. This interest in land as a bulwark of security is gen-
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erally shared by both the individual family and the larger kinship or clan unit, making it difficult for the individual to sell it to outsiders, even though he may have unchallenged rights to use it and transfer it by inheritance.

Implements and labor

Another marked feature of African agriculture is the almost negligible investment in buildings, tools, and implements. Barns and cattle stables or sheds are rare. Over much the greater part of tropical Africa the hoe and the machete are the only agricultural tools. While ox-plowing has made tremendous progress in certain areas, it has failed to catch on in many other areas even where the keeping of livestock is not prevented by the prevalence of the tsetse fly. The use of ox-carts or other animal-drawn carts, which are considerably more expensive than plows, is as yet very limited. The number of tractors in use is much smaller still, despite a recent trend to adopt such machinery as a shortcut to the modernization of cultivation. As will be shown later, the continued reliance on hand tools and the limited availability and suitability of other equipment create one of the principal problems of African agriculture.

This problem of implements is particularly acute owing to the labor bottlenecks which often adversely affect the timeliness and the thoroughness of agricultural operations or restrict the area which can be effectively tilled. Much of tropical Africa is characterized by a sharp demarcation between wet and dry season, and by a relatively short rainy season. The climatic pattern imposes a rigid scheduling of agricultural operations if the farmers are to plant their crops on the advent of the rains and to keep abreast of the sudden burgeoning of competitive vegetation. While there are densely populated areas where labor is redundant, the available farm labor supply over much of tropical Africa is often unable to cope with the workload at certain times of the year. This accounts in considerable measure for the apparently slipshod and hurried methods of tillage, planting, and weeding which so strike the outside observer.

The separation of crop and animal husbandry

Finally, there are characteristic relationships between animal husbandry and cropping which should be noted. That the two are but rarely integrated into the system of mixed farming so familiar to Europe and the United States is rather widely recognized. The production of fodder and establishment of pastures for livestock are seldom practiced; and the use of animals for systematic production of manure to increase soil fertility or, as already indicated, for
draft power, remains extremely limited. The feeding of livestock is almost entirely dependent on natural grazing and browsing, supplemented to some extent by crop residues. Except for the very few areas where pasture land has been enclosed, livestock are traditionally permitted to graze or forage anywhere except on land that is actually under crops.

This continued separation of livestock and crop husbandry appears to be due to a number of factors. Many livestock are still kept by such pastoral tribes as the Turkana and Masai of Kenya and Tanzania, and the Karamajong of Uganda, and the Fulani of West Africa, who for the most part roam over areas unsuitable for agriculture. Most of the remainder are apparently owned either by pastoral tribes who have gradually settled down to agriculture, or by other tribes who have been strongly influenced by pastoralists. Both of these tend naturally to consider their livestock as an adjunct to agriculture, and to handle them as if they were pure pastoralists. The climate, too, is an important factor. Cattle are largely concentrated in the rather dry areas where rainfall is confined to a short season and it is frequently necessary to move livestock in search of grass and water, and the need to move cattle far from the sites of cultivation militates, of course, against its integration into agriculture. In West Africa a number of agricultural tribes own cattle, but find it expedient to entrust these for herding to pastoral Fulani who can “follow the grass.”

The extent of change

Over time the traditional ways of using the land, whether for cultivation or for grazing, have undergone considerable modification. The source and nature of these changes have varied. The growth in population has generally produced a curtailment of bush fallow, sometimes resulting in soil erosion and loss of soil fertility; and in limited areas, where demographic pressures have become particularly acute, it has brought about more labor-intensive methods of land use which no longer rely on fallow for maintaining soil fertility. But the greatest changes have come from without. New crops and types of livestock have been introduced from other continents. Modern science and technology have put at the Africans’ disposal more productive crops and livestock, fertilizers and insecticides with which to raise yields, and new tools and implements to facilitate cultivation; and multiplying contacts with the outside world and the spread of education have made people more receptive and desirous of change. Production and trade have developed significantly.
Yet in many ways the nature and extent of the changes have fallen far short of the expectations of those who have been engaged in stimulating agricultural development. New crops have been adopted, but often without the methods of crop husbandry that agricultural experts considered necessary to the achievement of the best results. Innovations have "added" to African agriculture, but they have not generally transformed it. In most cases they have left much of traditional agriculture unaltered, and in some cases they have upset the equilibrium inherent in the old methods of land use without producing new balanced systems of farming.

The case studies appended to this volume provide striking evidence both of progress and of frustration of development efforts under a variety of conditions. They tend to show that much of the frustration arises from an inadequate understanding of the total environment in which development must take place. One must know the farmers and their reactions to all the factors of their environment if they are to be persuaded to adopt new crops or practices on land they are already using or to accept resettlement on new land under specified conditions. There must be a full appreciation of the ways in which indigenous farming has been conditioned by the natural milieu, the labor resources and tools available, and the values, customs and structure of the society to which the farmers belong. Only in this way can one discern the basis from which efforts to innovate must depart and realize the possible implications that particular innovations may have for the whole complex of interrelated factors affecting the potentialities and the rate of change.
CHAPTER THREE

THE STATE OF KNOWLEDGE:
THE NATURAL MILIEU AND RESEARCH

The natural and physical factors

The need for information

Natural environment obviously conditions closely what has been and can be done with the land. In tropical Africa this must be especially emphasized, since, as we have already noted, soils are poor and rainfall is deficient over large areas. The type of soil, the length of the rainy season and the distribution as well as the total amount of rainfall set important limits to the amount of grazing available for livestock, the crops that can be grown and the time within which they must be cultivated. Over much of tropical Africa the season within which crops must mature is very limited, thus putting a premium on the proper selection of crops and the determination of optimum planting dates on the basis of prevailing rainfall patterns.

The great variability of natural conditions in terms of place and time is particularly important. In rainfall, for instance, the average amount that may fall over a period of years has much less significance than the probability that within a given agricultural season enough rain will be available to germinate seed and ensure the survival of seedlings. There are often critical variations in rainfall within limited geographic areas. Differences in altitude and other natural conditions frequently produce, as in Kenya, a wide variety of ecological zones and transitional zones where suitability for different types of development must be separately assessed. Accurate knowledge of small variations in relief are obviously essential to the proper planning of an irrigation network.

An appreciation of the dynamic interaction of man and his natural environment is also critically important. Man can alter natural conditions to his benefit or to his disadvantage. Existing and evolving
ways of using the land have constant repercussions on ecology just as the latter in turn conditions the production possibilities. It is sometimes said that in Western Europe man has made the soil through a process of constant improvement, but in Africa man has more often contributed to the deterioration of his own habitat. The growth of population creates the need for a periodic reassessment of the way in which man is adjusting to his environment. The ecological conditions in any area must be susceptible of comparison with the number of people, together with the crops and the livestock they raise for their support, if an adequate understanding of the development problem is to be achieved.

We have remarked that the African cultivator and herdsman often evidence a good knowledge of the potentialities of their land. It will usually be desirable to determine and evaluate whatever knowledge they have, particularly when information from other sources may be far from complete. However, much of this knowledge cannot be readily collected, and much may no longer be relevant to changing conditions and changing requirements. The African farmer or herder obviously does not keep rainfall records even though his own practices may be conditioned by his recollection of past experience with the timing and distribution of rains. His method of identifying soil types does not usually correspond to the criteria used by modern scientists in classifying soils. Moreover, while his evaluations of the potentialities of soils and vegetation may be pertinent to the types of crops he has been growing or the types of livestock he has been keeping, they may not be relevant to new crops, improved varieties, and other kinds of livestock which are being introduced and which may be quite different in their requirements for nutrients and water.

Some deficiencies in knowledge

There is no doubt that over time much information on the natural environment—soils, climate, vegetation, surface and underground water resources, topography, etc.—has been collected and used for successful development programs in Africa. It is impossible and even undesirable, of course, to accumulate in advance all the data that may be needed under various circumstances. It is important, however, that no development program or project be launched without a knowledge of the relevant natural conditions or a proper utilization of this knowledge. Unfortunately there have been and continue to be quite a few cases where success has been prejudiced by a failure to keep this need in mind. The lessons of past experience in this respect appear to require constant repetition. The well-known "groundnuts scheme" in Tanzania failed in part owing to inadequate
knowledge of soils and rainfall, but even in recent years important schemes have been launched with little more information. The impatience to begin projects, often politically inspired, and the failure of those who hold the pursestrings to understand the importance of adequate data on soils, climate and similar factors have contributed to the recurrence of such cases.

Where large investments are involved, as in the case of irrigation and agricultural mechanization schemes, the consequences of proceeding without adequate knowledge or consideration of the relevant factors may have particularly serious consequences. For example, in analyzing the experience of the Office du Niger, an irrigation scheme in Mali which was started in the late 'twenties, we found that the rainfall had been seriously underestimated, no prior soil study had been undertaken and the topographic survey had proved seriously inadequate. The rainfall was subsequently discovered to be too great to realize a plan to grow long-staple cotton as on the Gezira scheme in the Sudan. When more data on rainfall became available, it was evident that in many parts of the scheme cotton of shorter staple could even be grown without irrigation, though with irregular yields. The drainage canals of the scheme continue from time to time to have difficulty in evacuating excess rainwater. More important, however, has been the fact that the irrigation network was laid out on the basis of topographic information which ignored important variations in micro-relief. As a consequence considerable areas are poorly drained or incapable of effective irrigation. The irrigation system was also constructed without taking into account variations in soils and their susceptibility to drainage. Serious soil investigations were undertaken only after the Second World War.

In Kenya the two small irrigation schemes we visited also had suffered to some extent from the failure to gather in advance all the relevant information. There, an excessively precipitate start was dictated by the availability of people from prison labor camps to do the necessary work. On one scheme—Mwea-Tebere—this led initially to the inclusion of an area with a type of soil which was found to pose difficult and unresolved problems of irrigation. Here the mistake was corrected before it produced a serious misinvestment, but for the other scheme—Perkerra—the consequences of the overhasty start have been more permanent and significant. At Perkerra the employment of basin irrigation and an inappropriate irrigation duty on a type of soil which proved difficult to drain have produced a heavy infestation of nut grass (*Cyperus rotundus*) which has made a little over a fifth of the area largely useless.

In more recent years much more care has been devoted to the
proper preparation of projects, particularly with respect to the technical aspects. Yet there are still too many cases where attempts to modernize agriculture, involving rather heavy expenditures on machinery, fertilizers and insecticides, are being started with little or no prior study of important variations in soils and micro-climate which may significantly affect the outcome. In Sukumaland (Tanzania), for example, mechanized "block" farms to produce cotton were launched in 1964/65 after only hasty and cursory investigations to determine the most suitable areas.

Our observations would generally confirm the judgment of Allan that the knowledge of soils in intertropical Africa is still "woefully meagre." The same can be said of data on rainfall. In fact, insufficient information on the "climatic parameters" has been a particularly serious handicap over the wide areas of Africa where both total rainfall and its distribution throughout the season are highly erratic, affecting the response to fertilizers and the determination of proper date of planting. In a number of cases, insufficient knowledge of significant local variations in the amount and pattern of rainfall have produced generalized recommendations on sowing dates that have done considerable harm and helped to discredit the agricultural extension service. In the District of Central Nyanza in Kenya, for instance, we found that the staff of the Lint and Cotton Seed Marketing Board and of the Department of Agriculture were recommending different sowing dates for cotton in the same areas, each undoubtedly proceeding from certain assumptions about the rainfall. In the central region of Upper Volta, the fact that farmers often had to do considerable resowing of their crops as the result of a drought following the first rains indicated that the sowing date generally practiced might be too early. However, the agricultural extension organization operating in this region was as yet unable to counsel a better planting date because sufficiently detailed information on rainfall had not been collected and the necessary experimentation with various sowing dates had not been undertaken. In the Bokoro region of the Chad we also found that the data did not make it possible to make sound recommendations on sowing dates.

Almost everywhere we noted a tendency to prescribe uniform dosages of fertilizers in areas where there was obviously more than one type of soil and rainfall. While there is ground for believing that many different types of soil are characterized by a common deficiency in phosphorus or nitrogen, this does not mean, of course,

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that the response to an identical dosage would necessarily be the same under highly varying rainfall conditions. Farmers who are persuaded to spend part of their limited resources on fertilizers are entitled to an assurance that they are not taking unnecessary risks by using either too little or too much fertilizer for the particular conditions under which they are working.

Sometimes new varieties have been introduced in areas where climatic conditions subsequently proved unsuitable for them. In the Ivory Coast, for example, the robusta variety of coffee was distributed in place of the Kouilou variety which had been subject to an epidemic of tracheomycosis. Afterwards, however, it became evident that robusta, owing to its greater susceptibility to drought, simply would not thrive in some of the places where Kouilou had flourished.

In Kenya it was difficult to explain the failure of attempts to deal with the problems of some of the drier areas we visited because of the lack of information on the relationship of the population and its livestock to its natural environment. In the Baringo District, for example, there was reason to believe that the constant difficulty with attempts to control grazing and livestock numbers stemmed basically from overpopulation and the inability of the grazing areas to support the minimum livestock people needed for their livelihood. However, conclusive evidence of this was unobtainable not only because the data on population and livestock were inadequate but also because the information that was available could not be clearly related to defined ecological areas. In parts of Machakos we encountered a rather similar situation. There an attempt had recently been made to show population densities by ecological area, but it was readily apparent that not much reliance could be placed on the results.

The need for further investigations

It must be conceded, however, that the demand for more detailed knowledge of the “ecological parameters” can be pushed too far. Indiscriminate gathering of data can be both unrewarding and excessively costly. The nature, scope and costliness of any investigation must be clearly related to particular objectives and the importance of these objectives. Where crops repeatedly fail to mature because of frequent droughts following the initial sowing, the crucial need may well be to develop more information on the degree of probability of a minimum adequate rainfall during the early part of the season. Such information may take a considerable time to collect, but this should provide no excuse for delay, especially since
the installation of the necessary rain gauges is not very costly and their control can be entrusted to agricultural or other government personnel already available in the field. For irrigation schemes involving a heavy investment it is obviously necessary to undertake a detailed investigation into soils, climate and topography in order to determine not only the suitability of the project area for various types of crops, but also the requirements for irrigation and drainage. Soil surveys can be very expensive, so that their scope should always be kept to the essential minimum. Where a given crop has long been grown, for example, it can often be assumed that farmers have learned to plant it on the most suitable soil available. If an effort is to be made to improve the yields of that crop, it is not necessary to map the soils in the area, but to determine by what cultural methods the productivity of the particular soils on which the crop is grown can be raised. Conversely, if the introduction of certain new crops is contemplated, the preparation of a soil map does become relevant. Even then it may be possible to limit the focus to the special soil characteristics—depth, degree of acidity (pH), nutrient status, capacity for water retention—which are likely to be immediately relevant to the crops or patterns of land utilization that are being considered. In other cases the danger of erosion may be so acute that the susceptibility of soils to erosion may have to be the focus of attention. Often the standard type of soil mapping which classifies soils by their physical characteristics and chemical composition may be needed or may, in fact, not be readily usable. The type of ecological survey which was pioneered by Trapnell in Northern Rhodesia (Zambia) and has been increasingly employed in former British Africa may be more pertinent as well as less expensive. This kind of soil-vegetation study infers essential soil characteristics from the types of vegetation supported by the soil and has the special merit of being more readily understandable to the African who, as

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2 We found, for example, that in the central region of Upper Volta, where soils are for the most part thin, the most important single factor in determining yields appeared to be the depth of soil. By concentrating extension work on areas with deeper soils and therefore greater potential, it seemed possible to achieve more rapid results.

3 Thus it is often easier and cheaper to focus a soil survey on those soil characteristics which are especially pertinent to a projected development project than to carry out a detailed soil study according to uniform criteria and methods of classification which facilitate comparisons with other soil surveys but which may be less useful in determining particular development possibilities. The first type of survey falls more in the field of applied pedology, the latter in the category of fundamental soil science.

4 See C. G. Trapnell, _The Soils, Vegetation and Agricultural Systems of North Eastern Rhodesia_ (Lusaka, Government Printer, 1943).
we have noted, has frequently used a somewhat similar method of assessing soil capability. Such a survey can be done rather quickly and easily on the basis of aerial photographic cover, supplemented by ground checks. However, Allan has pointed out that there are limited areas where biotic and climatic factors have produced such land degradation that the remaining species of vegetation tend to reflect more the past misuse of the soil than its current potential.\footnote{Allan, \textit{The African Husbandman}, p. 13.}

It cannot be too often emphasized that the relationship between man and his environment should be constantly kept to the fore. Ecological, land use and demographic mapping should all be effectively integrated. For each ecological zone one must really know the type, size and growth rate of the population whose requirements have to be met and how this population is using the land in relation to the potential. Only then can we see the direction development must take and assess the possibility of not only sustaining but raising the standard of living of the people. In this context it is important to keep track also of significant changes in the relationship of the population and its natural environment.

\textit{Problems of agricultural research}

It must be recognized that the considerable number of research stations scattered throughout tropical Africa have undoubtedly done much valuable work. The expansion of export crops owes much to the development and multiplication of improved varieties suited to local conditions. Through variety selection and hybridization research stations have managed to produce high-yielding arabica and robusta coffees, cocoa, tea, oil palm, cotton, groundnuts, etc. Many insect pests and diseases have been identified and methods of combating them have been devised. A considerable amount of work has been done on responses to fertilizers. While the research contribution to food or subsistence crops has been much less impressive than in the case of export crops, progress has been made here and there in developing higher-yielding, more disease-resistant or more rapidly maturing varieties. It is our function, however, not so much to emphasize the significant accomplishments of the past as to point out the necessity of further research in relation to the problems of agricultural development in the future.

In some cases we did find that efforts to improve agriculture had been hampered because the research had not provided an attractive answer to the problems confronting the farmers. Even in a few in-
stances the technical means of increasing the production had not yet been devised.

Difficulties in applying research

Much research has not been applied, although it no doubt deserves to be applied. But very often the recommendations that have emerged from research have failed to meet the tests of "feasibility" and "appeal" that we mentioned in the first chapter as essential to successful agricultural development. In many instances we would agree with the judgments, applicable to the poorer countries in general, pronounced on this subject by a number of authorities: of Schultz, that to a considerable extent there has been a failure to develop new agricultural inputs which are really rewarding to the farmer; of McMeekan, that research has been poorly tailored to actual development needs and has not effectively linked economics and technology; and of Degraff, that applied research has above all been deficient.

In our view, therefore, research is not invariably so far ahead of practical application that the major, if not the sole, task is now to secure the dissemination of knowledge by properly directed agricultural extension and training. Often it can be said that research has not been sufficiently based on an understanding or appreciation of the existing methods of agriculture, of the constraints to which African farming is subject, of the types of innovations which can in practice be applied and which respond to farmers' needs.

It is by no means easy to devise methods of agricultural research which will maximize the chances that the results of such research will actually be applied. Agricultural production is extremely complex, and a large number of factors—physical, biological, economic, and social—are involved in effecting improvements. In research all these factors cannot be simultaneously taken into account. To keep the task manageable, only a few factors can be tackled at the same time. Research specialists must break down any problem into its major components, select those which appear to be particularly susceptible to improvement by research and define the potentially fruitful ways of approaching them. This choice of the factors on which research is to focus must be made, but it is very difficult and

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has far-reaching implications. It is difficult because any agricultural problem generally has more than one possible "solution." For instance, one can deal with parasites either by breeding a resistant variety or by developing an effective pesticide; one may fit a desired crop or plant into a given rainfall pattern by changing the length of the vegetative cycle through breeding or by supplying complementary water through irrigation; and it is possible to increase soil fertility by devising crop rotations including legumes or by using fertilizers and manure. Whatever choice is made has important consequences in terms of other development measures that must be taken or of other lines of development that must be pursued. Thus in the central region of Upper Volta we noted that a decision to improve the yields of sorghum, the principal subsistence crop, through the application of fertilizers made it necessary to develop a cash crop which would yield sufficient money to pay for fertilizers, but that this need would have been much less urgent if the attempt to raise sorghum output had concentrated on finding higher-yielding varieties of this grain. In Kenya, the decision to introduce exotic dairy cattle in the Central Province necessitated far more sweeping changes in traditional agriculture and animal husbandry than would have been necessary if a more modest objective of upgrading local cattle through selective breeding had been adopted. Similarly, when efforts are concentrated on the development and introduction of more productive but less hardy varieties of cotton, this means that interplanting of cotton and food crops must be abandoned and that the farmer must be enabled to prepare a larger acreage or shown how to adopt a feasible and effective crop rotation.

These examples, which could be multiplied many times, indicate that the orientation of research must be influenced strongly by not only the potential benefits to the farmer but by the possible repercussions on his whole method of farming. Experience has revealed that research has in many cases suffered from excessive technical bias and oversimplification. The technical bias is at times reflected in too exclusive a preoccupation with the maximization of output per unit of area without regard to all the related inputs that are necessary and the farmer's capacity to provide them. Thus when a new practice or technique worked out by research requires substantially more labor, it may be of no practical relevance to the farmer who considers labor rather than land as the factor limiting his output. Excessive specialization in research has also at times led to an oversimplification of the actual problems encountered at the farm level and has resulted in too much concentration on individual crops or improvements without sufficient regard to the farming pattern.
Research is done on particular crops—on cocoa, coffee, oil palm, cotton, etc.—and optimum planting dates, cultural practices, fertilizer applications and phytosanitary treatments are too often worked out for each crop in isolation. Yet the planting date that is "optimum" in terms of the yields of one crop may not be the best when the other crops that the farmer must plant are considered and account is taken of the best way in which the farmer can use his labor as a whole. To grow a particular crop in a pure stand may maximize the yield, but the net advantage will depend on the repercussions of this practice and the extent to which it is necessary to sacrifice other crops formerly grown in association with it. Recommendations for green manuring or for fertilizer or animal manure applications can hardly be geared to one crop in disregard of those that precede or follow it in any rotation. Yet a report issued by a number of specialized research institutions reached conclusions on the relative merits of various methods of increasing soil fertility on the basis of trials which in the majority of cases dealt solely with the effect on particular cash crops.\(^9\)

We certainly do not mean to suggest that there is no room for highly specialized and technical research; it has been extremely useful in providing some of the basic requirements of agricultural development in Africa and will continue to be particularly necessary for meeting the needs of the most progressive type of farm enterprises. But this type of research alone does not always provide a definite solution to the practical problems of the average farmer. The feasibility of new crops and improved techniques must be judged by the way they fit into the pattern of farming that is practiced in any given locality.\(^10\) In some cases there may be no problem. It may be possible to identify a particular pest which has seriously damaged a crop and to devise and apply a method of control without interfering with other farming activities. Similarly, a new and improved variety can have a beneficial effect by itself even though the realization of its full potential may depend on certain changes in crop husbandry. However, it is usually important to make sure how any innovation affects the interrelationships in the prevailing farming

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\(^10\) A former Professor of Tropical Crops at Kumasi University of Science and Technology has emphasized that the interrelationship of new practices does not mean that many must be promoted simultaneously but only that any new practice that is pushed "must have been carefully studied in the context of the local farming system, and especially from the labor demand and economic aspect." See J. Gordon, "Problems of Agricultural Extension in the Developing Countries," *Crops and Markets*, March 1965.
system. One innovation may well necessitate others of varying complexity. In Africa where so little equipment is used, the repercussions of a new crop or practice on the pattern of farm labor use tends to be particularly important. The extent to which a more fundamental and thoroughgoing transformation will be necessary will depend on the circumstances and the nature of the innovation. If there is a labor bottleneck and the introduction of animal- or tractor-drawn implements becomes necessary to break it, this may be only the beginning of a whole train of innovations. The use of implements may well necessitate thorough clearing and destumping of land. This in turn interferes with the restoration of fertility through bush fallowing and thus involves the adoption of other methods of fertilization such as the application of manures or fertilizers. If livestock are to be associated with agriculture to provide both manure and traction, this involves for the drier areas an end to transhumance and the introduction of a fodder crop in the rotation.

In a number of cases there has been insufficient concern on the part of research stations with the problem of fitting new crops and methods of cultivation into the existing farming pattern and rotation. At the Kibos Research Station in Central Nyanza District there was considerable experimentation with cotton, but no facilities for adapting this culture to the type of farming prevailing in the district. On the other hand, we noted an interesting example of successful applied research in the Bouaké Region of the Ivory Coast. There, the success that has so far been achieved by a relatively new program designed to foster innovations in native agriculture has been due in considerable part to advance testing of a package of new practices on a pilot scale and to the effective collaboration of a general agricultural research station and a specialized cotton research institution in developing an effective way of introducing a profitable cotton crop without upsetting the existing farming system based above all on the cultivation of yams as the principal food crop.

**Lack of technical means of increasing the production**

Several problems which limit the development of agricultural production have not yet been solved by agricultural research. Some are general, although they may be more or less acute in the different regions; others are more specific and restricted to certain crops or areas.

The main general problem concerns the conservation of soil fertility where long-term bush fallow is no longer feasible, either because population increase makes it impossible or because the introduction of equipment implies the clearing of the natural vege-
tation. No really satisfactory and definite substitute has yet been
developed for bush fallow. It has not been possible, for example, to
deal with the unexplained failure of legumes to produce nodules and
fix nitrogen under the conditions prevailing over most of tropical
Africa. Nor is it clear in many cases whether artificial fertilizers will
be effective in raising yields over the long run without some way of
replenishing the organic matter in the soil. Livestock can, of course
provide the organic manure, but the association of livestock with
agriculture necessary for this purpose can be brought about only if
forage or fodder crops can be grown; research has not in general been
able to develop fodder crops well suited to the drier areas where
sufficient natural grazing is unavailable over much of the dry season.
Green manuring crops, even if they can be turned under effectively,
have also failed to provide a universally satisfactory answer to the
soil fertility problem, usually because under many conditions they
tend to decompose either too slowly or too rapidly.

In many areas insufficient research has also been devoted to food
crops. Since food production for subsistence claims most of the
cultivated area and the farmers' labor, the low level of productivity
in these crops has often impeded agricultural development. For want
of better varieties and techniques in producing their own food many
farmers have been obliged to restrict the acreage and the time spent
on cash crops.

In Upper Volta where sorghum and bulrush millet are the staples
and farmers often experience difficulties in growing enough food, we
found that no higher-yielding varieties of these grains had yet been
developed and that the low potential of existing varieties made the
fertilizer dressing advised by the extension organization rather un-
profitable. Everywhere in the drier areas where the agricultural
season is rather short, early planting of cotton has been difficult to
achieve because research has not really found the means of rec-
oning it with subsistence production which is vital to the farmer;
and where each farmer is obliged to grow a certain acreage of cotton,
sorghum and millet have been replaced, to some extent, by cassava
which can be planted later and produces more calories per unit of
labor and unit of area but has notable nutritional deficiencies. In
the Bugisu District of Uganda, the lack of research on bananas, the
principal food, significantly limited the area which small farmers
could plant to arabica coffee.

In animal production one of the central problems is overgrazing
of much of the range land when population increases. In some of the
areas we visited in East Africa, including Baringo and Machakos
Districts in Kenya and Sukumaland in Tanzania, we had occasion
to examine and discuss the many attempts to deal with this problem through control of stock numbers, rotational grazing and other practices. The basic causes of the failure of most of these attempts are discussed elsewhere; here we wish only to point out that for the most part the supporting research was inadequate. In most cases research into the stock-carrying capacity of grazing land has been insufficient. In Sukumaland, for example, the ratio of stock to grazing land was fixed on the basis of the so-called "Sukumaland equation" which reflected a judgment rather than a scientific finding and failed to take into account the wide differences in natural vegetation and grazing conditions within the region. The Ukiriguru Research Station in Sukumaland has done some useful work on the carrying capacity of grazing land, but its findings are applicable only to the conditions where the station itself is located. In Kenya the ratios were also determined largely on the basis of judgments of which some were no doubt soundly based in turn on observation and the experience of European ranchers in the country, but others appeared somewhat arbitrary and did not take sufficiently into account the significant variations in grazing and "browse" potential.\footnote{Commenting on the determination of carrying capacity in tropical Africa, Allan has observed: "No one can say with any certainty what these carrying capacities are, for there is little factual evidence and there is need for a great deal of experimental work on a wide range of pasture types. The work carried out so far has been concerned mainly with selected types of grasses and improved methods of management rather than with the nutritive value and carrying capacities of natural grazing under traditional systems of usage." See *The African Husbandman*, p. 292.}

In many of the areas we visited we also noted particular shortcomings in research. In Kenya, research stations and the substantial colony of European farmers had together undoubtedly developed cropping and animal husbandry practices which were well suited to the mixed-farming areas of the higher parts of the country. Elsewhere and particularly in the drier portions of Machakos, Central Nyanza, Elgeyo-Marakwet and Baringo Districts, the position was much less satisfactory. Research had not devised a "package of improvements" that was very appealing to the farmer. Widespread trials to determine suitable fertilizer applications under varying conditions had not been conducted. Similarly, trials to determine optimum planting dates had often not been undertaken. A few short-maturing maize varieties had been developed, but while their average yield over good and bad years taken together was superior to that of the indigenous maize, the fact that their yield potential was lower than that of the native types during years of good rainfall has proved a serious obstacle to their adoption. In Central Nyanza,
where the cultivation of sugar cane offered one of the comparatively
good opportunities for developing agriculture, there was no research
station devoted to the selection and testing of varieties suitable to
local conditions. In Machakos District we found an excellent re-
search station, but one which had no substations or other facilities
for conducting trials under the widely varying ecological conditions
of that district.

In a few of the areas of West Africa where we examined the effect-
iveness of certain agricultural extension efforts it was obvious that
research had not provided a basis for developing the admittedly
very limited agricultural potential. Thus in the Mossi country
around Ouagadougou, the capital of Upper Volta, research had not
as yet produced suitable cash crops; and the agricultural extension
organization was promoting the adoption of rather expensive
fertilizer applications before research at the Saria Experimental
Station had fully demonstrated their effectiveness. In the Bokoro
region of the Chad there had been virtually no research yielding
improvements in agricultural practices which could be disseminated
by the extension service.

Some requirements of research

Effective agricultural research can be developed only if (1) it is
based on a sound knowledge of local farming systems, (2) more atten-
tion is paid to the improvement of food crops and of the general
system of agriculture, (3) the economics of various innovations are
more comprehensively appreciated, (4) sufficient trials and demon-
strations are undertaken to test the practicability of recommenda-
tions, (5) staff is made available in adequate number and quality,
and for sufficiently long periods, and (6) there is greater inter-
national cooperation in the exchange and utilization of research
results.

The Need to Understand Indigenous Farming. We have already illus-
trated the relevance of such an understanding in a number of ways.
Here only two additional observations will be made. The first is
that the understanding of "indigenous farming" should extend not
only to the factors limiting the farmer's output and conditioning
his responses, but also to the whole problem of land use that is
emerging from the changing relationship of man to his environment.
The second relates to the method of acquiring this understanding.
This is not easy to achieve, partly because research does have to be
broken down into many specialized tasks requiring specialists of
various kinds whose work must be properly coordinated. Ideally,
the problems on which research should focus and the human, eco-
nomic and ecological parameters within which it must be conducted should be determined by the cooperative efforts of agricultural extension workers, ecologists, economists and sociologists. The research station can and should, of course, be in close and continuing communication with agricultural and veterinary field staff who can appreciate the practical problems requiring attention. However, key personnel should themselves be given an opportunity to get first-hand knowledge of the whole environment in which their contributions are to be made. It must not be forgotten that research personnel are still almost wholly expatriate, that many have come and are coming to Africa with only a knowledge of temperate zone agriculture and that it will be a long time before sufficient African scientists will become available to replace them. Moreover, as one authority has pointed out, "This lack of basic understanding of local farm practices . . . is very widespread, even amongst the highest ranks of the home-grown agricultural scientists, a lack which the current practices of lavish provision of agricultural scholarships and fellowships for basic training and for advanced special study in the developed country exacerbates."

In any event opportunities should be given, particularly to those concerned with applied research, to familiarize themselves with indigenous farming by travelling in the area served by the research station and keeping in close touch with both farmers and extension personnel. Another practice that might be more generally adopted would be the assignment to a research station, for an extended period, of an agriculturist with long practical experience in the field. We noted, for example—and other instances could be cited—that a very pertinent and practical orientation had been given to the work at the general agricultural station near Bouaké in the Ivory Coast by an agriculturist who had the dual function of directing the research station and the agricultural field service.

An Integral Approach to the Farm Problem. This approach is important if the results of the research are to be "appealing" to the farmers. In our opinion there are not enough research stations dealing with general agricultural problems and food crops. In French-speaking Africa most of the research is carried out under contract with organizations which have their headquarters in Paris and which are oriented toward special cash crops. Thus there are special organizations devoted to oil crops, cotton, coffee and cocoa, fruits and rubber; and there is only one, focusing on food crops, which can lay

12 Gordon, "Problems of Agricultural Extension in the Developing Countries."
13 Institut de recherches pour les huiles et oléagineux (IRHO); Institut de recherches du coton et des textiles exotiques (IRCT); Institut français du café, du cacao et d'autres plantes stimulantes (IFCC); Institut français de recherches
claim to a more general competence.\textsuperscript{14} Admittedly, specialized research institutions have certain important advantages in recruiting highly trained personnel and obtaining quick results by focusing all their attention on one crop. We would not recommend that they be abandoned, but rather that a much greater emphasis be put on general agricultural research stations so that the work of specialized research institutions may be properly related to the farm problem as a whole. It may be objected that this is not so important for institutions devoted to research on tree crops since these are not, in any event, regularly rotated with other crops. However, it must be kept in mind that tree crops in the early stages are often grown in association with food crops and, above all, that the practicality and economics of recommended inputs on such crops must inevitably be determined in the light of the availability and alternative employment opportunities of the labor, land and other resources used on the farm as a whole.

\textit{More Focus on Economics.} The third requirement—more attention to the economic aspects of the research recommendations—would already be met more easily if there were a better understanding of local farming, its rationale and its constraints. It would help, however, if an agricultural economist were assigned to the more important research stations or, as a minimum, spent some time at a research station to evaluate the economics of research recommendations and improve the economic orientation of new and current research. A resident agricultural economist can, among other things, make farm management studies in the area which will highlight the practical problems faced by the farmer. At the Ukiriguru Research Station in Sukumaland we found that the farm studies of such an economist had given the research personnel a much greater appreciation of the practical obstacles to the adoption of some of the recommendations that had emerged from research in the past.

\textit{Greater Emphasis on Applied Research and Trials.} The fourth requirement—sufficient trials and demonstrations—must be met not only to take into account the great variety of ecological conditions but to test practices as much as possible under actual farming conditions before an attempt is made to disseminate them more generally through an extension service.

From the standpoint of comprehensiveness of both subject matter and ecological conditions, the research organization developed by

\textsuperscript{14} The Institut de recherches agronomiques tropicales et de cultures vivrières (IRAT).
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the Belgians for the Congo and Ruanda-Urundi was in many respects a model. Radiating from the headquarters and central research station at Yangambi, there were some forty other research centers, experimental stations and farms, and many of these carried out in turn numerous field trials. This organization was also concerned with the practical application of research, had a special division concerned with agricultural economics and sociology and pioneered the development of *paysannats* which in their various forms represented attempts at integral modification and transformation of traditional farming patterns. We are not suggesting that these efforts were fully successful, particularly in dealing with the sociological factors, but they did reflect in principle a concern with the whole of the problem encountered in the field.

A number of French-sponsored and French-supported research institutions have also demonstrated an interest in testing research findings in the peasant milieu. This is reflected in what the French call *prevulgarisation*, which in essence means the testing of approaches and methods in pilot sectors before their application. We have already mentioned, for instance, the pilot schemes which preceded the more general dissemination of a "package" of improvements in agriculture in the region centering in Bouaké in the Ivory Coast. Other examples could be cited. Thus the French Institut de recherches pour les huiles et oleagineux (IRHO) has undertaken pilot projects to introduce selected oil palms on farm holdings in villages surrounding its research station in the lower Ivory Coast, and to test higher-yielding groundnut varieties, improved methods of cultivation and new rotations in parts of Senegal and Upper Volta. Here again we would not assert that these efforts were necessarily all well conceived or that the pilot schemes were always properly evaluated. We wish, rather, to stress that this preoccupation with the practical application of research is sound and that this practice, which is still rather exceptional, needs to be greatly extended.

**Staffing.** Adequate staffing of research stations has become increasingly difficult and may well present an even more acute problem in the future. Few Africans have as yet had both the qualifications and inclinations to take up agricultural research as a career, and it is

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16 See the annual reports of the IRHO for these countries; also "IRHO: 1942–1962, vingt ans d'activité," *Oléagineux*, No. 4, 1962.
likely to be a long time before there is a considerable cadre of ade-
quately trained African scientists. Meanwhile, many of the ex-
patriates who fill research posts feel they have no assured future, and it is obviously difficult to induce young non-Africans to pursue the long training essential for qualification in tropical agriculture unless there are definite opportunities for a lifetime career. Already many posts are unfilled and many others are filled only by persons who are less well qualified than their predecessors and who are only on comparatively short-term assignments. Long-term career op-
portunities are needed not only to attract the necessary personnel but to give them the deep knowledge of both the theoretical and practical problems that can only be acquired through long ex-
perience. Moreover, continuity of personnel is vital to agricultural research. In most cases satisfactory results can be obtained only by many years of continuous research and experimentation. Under present conditions the rapid turnover of personnel often results in the discontinuation of old research before it has reached conclusions and the adoption of new projects which in turn are left unfinished.

The prospect that the world will be dangerously short of qualified personnel in tropical agriculture is very real. A careful consideration of measures that will be effective in obviating this possibility is necessary. We have not had the time and do not have the competence to explore in detail what these should be. One possibility may well be to provide the necessary career opportunities within international organizations and regional centers or within national agencies, organizations, foundations, and universities in the more developed countries. It has already been pointed out that France has main-
tained in being a number of research organizations which have a more or less permanent cadre of scientists and, under arrangements

Praeger, 1965). Among other things, Dr. McKelvey states that (1) “research in Africa lacks the element most essential to its continuation; a cadre of adequately trained African scientists”; (2) there are still too few faculties of agriculture in African universities; (3) the five higher educational institutions which currently or formerly had a special relationship with the University of London and are located in East Africa, Ghana, Nigeria, Sudan, Rhodesia, and Nyasaland graduated only 154 people in agriculture during the ten-year period 1953 to 1962; and (4) six African students who in recent years obtained a degree in agriculture all entered other fields because the “absence of a corps of successful African career men in agricultural research left these students without inspirational leadership or the desire to pursue agriculture.”

18 Such as the International Institute of Tropical Agriculture currently being established in Nigeria, with the support of the Rockefeller and Ford Foundations, which will combine food crop research with advanced training in tropical agriculture.
with the appropriate government, continue to carry on research in most countries that were formerly under the French flag. On the British side, however, there are no corresponding organizations except for the Empire Cotton Growing Corporation which is able to make cotton specialists available for research. National organizations of this type may well help materially in filling the gap, particularly if they also increasingly afford employment opportunities to Africans who want to pursue a research career. However, many countries may well be reluctant to rely entirely on such organizations and may welcome the creation of an international cadre of research personnel.

*International Cooperation in Utilization of Research.* In view of the shortage of research personnel and facilities it is important not only that research be focused on the critical problems, but also that the results be widely disseminated in such a way as to avoid duplication as much as possible. In the coffee-growing area of Mount Elgon, Uganda, research has been inadequate in many respects, but the deficiencies probably could have been overcome at least in part by taking advantage of the work done in some of Kenya's coffee areas where conditions were not dissimilar. International meetings and scientific periodicals undoubtedly provide opportunities for disseminating research knowledge. It seems to us, however, that there is need for a less piecemeal, more systematic and periodic assessment of the research that has been accomplished. Such appraisals should be carried out for various groups of research institutions that operate under more or less similar ecological conditions. They could gradually lead to greater coordination and economy of research efforts. A test appraisal of this sort might be undertaken by an international organization such as the FAO and its conclusions should have a very large diffusion.
CHAPTER FOUR

THE RURAL SOCIETY: FACTORS AFFECTING RECEPITIVITY AND INCENTIVES TO CHANGE

Introduction

In the last chapter we emphasized that a considerable part of past agricultural research has not been applied because it proved to be impracticable or unrewarding from the standpoint of the farmer. More broadly, it can be said that failures in agricultural development are largely traceable to inadequate knowledge or insufficient appreciation of the relevance of all the socio-economic factors that determine the proper approach to the farmer and that condition the farmer's responses and receptivity to change. The development of agriculture is not a purely technical task. It can succeed only with the cooperation of the farmer and on the basis of an understanding of the society of which the farmer is part. It requires an interdisciplinary approach which calls on the knowledge and analytical methods of not only the agriculturist and the agricultural economist, but also on that of the sociologist or social anthropologist.

The need for an interdisciplinary approach

Today the vital importance of the agricultural economist is generally recognized, at least in theory if not always in fact, but the role that the social anthropologist can play is the subject of much more controversy. A leading member of this discipline has stated that "the primary concern" of social anthropologists is "to develop knowledge and understanding of human behavior in society, the nature of human interaction and relationships, and the patterns of activities with their concomitant ideas, values and symbols." On the basis of such a definition the relevance of social anthropology to agricultural development can hardly be challenged in principle.

Yet in practice there has been some justified skepticism about the value of getting help from social anthropologists in devising programs and policies for agricultural development. One of the reasons has been the disinclination of many anthropologists to focus on those aspects of human behavior of particular relevance to agricultural innovation or even on the process of social change as opposed to a generalized description of society at a particular point in time. The agriculturist concerned with practical problems of development wants to know what behavioral patterns and values are at odds with particular courses of action and how best to induce constructive change in terms of achieving production goals. Another reason has been a tendency to stress the social group to the exclusion of the individuals composing it. Thus one authority on rural development has rightly said that "the first step for sociologists is to keep constantly in mind the fact that farmers are individual persons, and that this is at least as important to development as the other fact that farmers are members of social groups." A third reason for the skepticism is the frequent unwillingness of anthropologists to come to conclusions until after long, detailed and time-consuming studies. They must be willing to risk a quick diagnosis of the factors making for or militating against specific changes if they are to make timely contributions to agricultural development. This is particularly important today when Africa is undergoing rapid change under the impact of a multitude of modernizing influences.

Yet efforts should be made to enlist the assistance of properly qualified social anthropologists interested in, and oriented toward, the analysis and inducement of social change. They will probably not be available in sufficient numbers to enable them always to participate directly in the formulation of agricultural development programs or policies. In most cases they may have to be used to give the agriculturists and economists a better understanding of the social framework to which such programs and policies should be adjusted. In other words, the approach of the agriculturists and

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3 Professor Phillips has put this well: "Clearly desirable is the analysis of family, group, tribal and natural subsistence and exchange economies in the light of information won by the social anthropologist. But time marches on—and conditions change and nowhere more rapidly than in the wilder parts of Africa suddenly exposed to new influences and opportunities. Academic study must be accelerated if this change is not to render obscure so much that is being altered and even discarded in the lives of people once far removed from external influences." See John Phillips, *Agriculture and Ecology in Africa, A Study of Actual and Potential Development South of the Sahara* (London, Faber and Faber, 1959), p. 320.
economists can be broadened to give them some capability of dealing with the sociological aspects of their work. However, where societies are still predominantly traditional, where little or no development has yet been initiated or where past development efforts have repeatedly failed, it is certainly important to have a social anthropologist participate directly in the diagnosis of the situation and the elaboration of a course of action based on this diagnosis.4

It is above all necessary that the work on the sociological, economic and more purely technical aspects of agricultural development be closely integrated. The whole of the problem must be kept constantly to the fore and periodically reassessed at various times. Just as the agricultural economist has often worked in too much isolation from the agriculturist, so the social anthropologist has often been left to pursue his studies alone. Such isolated studies may well prove interesting, but they frequently have no immediate bearing on practical development problems or issues simply because they have not been properly focused. We have had occasion to consult a number of sociological studies of communities which were obviously undertaken as a prelude to a development effort. Frequently these do yield some knowledge relevant to agricultural development, but this is just as often buried in a mass of information whose relevance, if any, is not readily apparent to the practical agriculturist responsible for development. Moreover, there is seldom an attempt to draw from the analysis conclusions about proper approaches to the development problem. Such situations can be avoided only if the terms of reference are clearly spelled out by the agriculturist and economist in consultation with the social anthropologist. The latter is entitled to know precisely on what questions he is expected to throw light and in turn to indicate what questions he feels competent to deal with.

Features of rural society relevant to agricultural development

It is difficult to enumerate even the major characteristics or features of the social and economic life and organization of a community

4 "The work of the anthropologist or sociologist can be of the greatest importance in guiding those charged with planning the development of traditional societies. A society will accept, or reject, or be disrupted by social and economic change because of qualities residing in customary law, in the kinship structure, in the sanctions, duties, obligations and rights which govern the relationships of individuals of different age, sex and status, and in the attitudes of parents towards their children. But given some understanding of these things the dangers of development should be avoided and the potentialities realised for a fuller and more flexible life. It is when development is imposed as a theoretical blue print for prosperity having no relation to the social realities, that suffering ensues." Adam Curle, "Tradition, Development and Planning," Sociological Review, New Series, Vol. 8, No. 2, December 1960.
that may be relevant to the development of agriculture and that may accordingly require attention. Below we have nonetheless attempted to list and comment on some of these. It should be understood, however, that both the subjects covered and the comments made are intended to be only illustrative or suggestive, and that our primary purpose is to emphasize the wide range of problems to which those concerned with agricultural development must address themselves. No special significance should be attached to the sequence in which the subjects are treated or grouped. Their importance and relevance as well as their interrelationships will in any event vary considerably, depending on the particular situation. In one way or another they may determine the nature and direction of the development effort, the appeal and practicability of proposed innovations and the approach that is necessary to get people to accept such changes.

1. The distribution and density of population in relation to natural resources and prevailing methods of land utilization. We have already emphasized the importance of these interrelationships in determining whether the carrying capacity of the land is being taxed at existing levels of management, and what can or must be done to relieve emerging population pressures through resettlement or through conservation and better employment of the natural resource potential. Unless there is an accurate assessment of the extent to which people themselves experience the effect of population pressure on land, costly irrigation and land colonization schemes may fail to attract settlers and labor in numbers sufficient to achieve economic levels of output. The relative scarcity of land and labor must also be known in order to determine whether efforts ought to concentrate on maximizing returns to one or the other factors of production. The seasonal labor requirements and rate of labor utilization inherent in the existing system of farming may vitally condition the feasibility of introducing innovations which demand more labor or involve changes in the seasonal distribution of labor. In this connection, the availability of draft animals, implements and machinery to supplement existing labor resources can obviously also be of considerable importance.

2. The pattern of settlement, whether in the form of villages or dispersed farm homesteads. Settlement patterns may have important implications for extension work and general administration as well as for the supply of water, medical services, educational facilities etc., etc., which can have a significant bearing on agricultural development. Because nucleated settlements tend to create differential population pressures on land, residents committed to
village life may respond to efforts to intensify agriculture on the comparatively limited land near the village even though overall population density is low in relationship to land.

3. The attitudes, organization, and leadership of the society in which development is to take place. A high valuation placed on social interaction and the timely execution of certain social and religious activities may effect the willingness of many farmers to devote more labor to agricultural activities or to extend the cultivation season. A society's division into lineages or other kinship groups, large and small, and the strength of the bonds of such groups may be relevant in many ways. It may determine, for instance, the way in which new land can be acquired or settled, whether through corporate kin groups or through elementary families and individuals. Also, if there is considerable pressure within the society for conformity to traditional, socially acceptable behavior it may be difficult to induce isolated individuals to adopt innovations which tend to alienate them from their society. Instead, it may be necessary at first to work with some sort of a group. There may, however, be various types of groups based on ties of kinship, neighborhood or age, and their usefulness in the process of innovation will need to be carefully assessed. Some may serve purposes which have little or no relevance to cooperative action for increasing output. Others may be rent by internal strife which may make it impossible for them to pull together. There may well be various types of leaders—some traditional such as chiefs and lineage or neighborhood elders, and others emerging from newer types of organization such as political parties. Once these are identified and the nature of their authority assessed, some may play an important role in mobilizing public support for agricultural innovations. Others, less inclined to innovate, may actually impede change unless their opposition is neutralized. If old leaders never enjoyed much authority, or have lost the basis for their former support, and if new leaders have not yet emerged, special efforts may be required to discern which individuals in the society may have the capacity for leadership and the ability to command support for development efforts.

4. The nature, extent and distribution and the methods of acquiring and transferring land. All these aspects of land tenure tend to have an important bearing on land. Rights to land may have become increasingly vested in individual families, but larger kinship groups or the original land allocation authority may retain residual rights affecting in some way the use or disposal of land. Progressive individualization of land tenure may, on the one hand, create a feeling of security essential to proper development of the land, but may, on
the other hand, also impair flexibility in reallocating or regrouping land in the interest of promoting its better use. Where, as in much of tropical Africa, individualization of land tenure has affected only cultivation rights and has left grazing rights predominantly communal, this limitation may create serious obstacles to the improvement of animal husbandry and grazing land. A growing volume of litigation about land will usually be indicative of increasing land scarcity and the need for a definite settlement of rival claims. The practice of buying and selling land—by no means universal in tropical Africa—may reflect a realization of the increasing scarcity of land or of its development potential. Prevailing customs regarding inheritance may also affect development. Under conditions of growing land shortage, the division of land among a number of heirs may produce more and more serious fragmentation, thwarting efficient use of land unless consolidation can be effected. Whether inheritance is patrilineal (i.e., from father to son) or matrilineal (i.e., from the deceased to his sister’s sons) may have a bearing on incentives to develop the land, depending on circumstances which will usually require careful scrutiny. Finally, differences in land endowment among farm families, particularly in relation to their requirements and their capacity to utilize land, may significantly affect the degree to which various types of holdings are developed. Such differences also affect the availability of people with little or no land for hired labor, and the need for farm development programs sufficiently differentiated to take into account the various categories of land holdings.

5. The size and nature of the farming unit. These may affect both the incentives to develop land and the approach needed in extension work. In most of tropical Africa the nuclear family consisting of a man, his wife or wives, and their children, may be considered the basic land-using unit. There are still areas, however, where a larger extended family or kinship group functions as the basic unit. Here at least a part of the land may be tilled in common by the members of the group whose head has the power to dispose of the output. He may also have an important voice in determining the way land is apportioned and utilized, including the adoption of any innovations. Even the nuclear family cannot usually be treated as a single production unit within which land, labor and other resources are pooled and used for a common purpose. In agriculture there is a division of labor among men and women which, while differing from society to society and gradually changing, often creates a divergence of interests interfering with the full and most efficient use of productive resources. The woman’s primary responsibility and preoccupation
tends to be the cultivation of the food crops required to feed the family, although she may also undertake some activities, such as trade, that enable her to control some cash of her own. While the woman may also have her own cash crops in certain areas, the man is generally responsible for crops predominantly produced for the market, and while the woman may be required to work on such crops, she usually does not control or enjoy an assured share in the income therefrom. In agricultural extension work both men and women may need to be approached but the method of approach and the program of farm development proposed will usually have to be conditioned by the nature of the interaction among the members of the household and the extent of the difference or identity of interests among them. In this connection it may be important to acquire some knowledge of the evolving pattern of the farm family's expenditures, since this may reflect not only the wants that are developing but the degree to which cash income is being spent in the interest of the family as a whole.

6. The relative importance of different types of output and sources of income. This may give some indication of the possibility of various lines of development and of the focus of development effort. The willingness to use land and labor for new crops or methods of production will depend on the alternative opportunities open to the farmer in terms of actual or potential income from nonagricultural pursuits, including crafts, trade and wage labor, and from crops and livestock already being exploited. A knowledge of the comparative contribution, both actual and potential, of various types of crops and livestock to the farmer's output, consumption and income may help to give the right sort of emphasis to further efforts that would enable him to raise his standard of living.

7. The extent and type of labor migration. Many parts of tropical Africa are characterized by considerable migration of labor, not only between rural areas and towns, but from one agricultural area to another. Some of this migration may be assuming a more or less permanent character, but most of it is still temporary, with the migrants—mostly men—returning after long or short periods to their native regions, where they often have left their families on their farms or have at least retained some sort of claim to land which they can assert upon their return. Labor migration may be prompted by a variety of motives; a basic dissatisfaction with rural life and its constraints, in which case migration may turn into a permanent flight from land; or the need to compensate for poor income and labor opportunities by accepting more remunerative employment elsewhere. In the latter case, this need may arise from an actual
poverty of local resources, or from a failure, for a variety of reasons, to realize a development potential which does exist. In any event labor migration may have important implications for the development of agriculture. In areas where opportunities for profitable agriculture are available and are being exploited, the rate at which they can be developed may be initially determined by the ability to attract labor migrants from less favored regions. For the areas from which the labor migrants come the continued absence of considerable numbers of able-bodied men may perpetuate the stagnation of agriculture at a low subsistence level. This is not only because the migrants may include the more enterprising members of the community but also because many farms may be left with insufficient labor, particularly for such tasks as the clearing and breaking of land or plowing. Under such conditions government efforts to stimulate development may prove unrewarding, particularly where labor migration reflects a sound appreciation of the comparative opportunities afforded by local agriculture and employment opportunities elsewhere. On the other hand, where there is agricultural development potential which in the past has been ignored, the capital, new skills and desire for change acquired during periods of wage labor may enable returned migrants to recognize and take advantage of these potentialities. Whether this will happen will depend in part on the extent to which employment has brought the migrants into stimulating contacts with different behavioral patterns and values and given them the experience and work habits that are useful in their home environment.

8. Levels of education and the extent of knowledge and experience of the outside world. These condition receptivity to innovation and the strength of economic motivations. Formal education, while important, is far from being the only means of acquiring this knowledge and experience. The role that may be played by labor migration has already been cited. Contacts with cities and markets as well as the practice of trades and other occupations, can greatly extend horizons. Participation in various voluntary associations such as community self-help groups, local area councils, political parties and religious organizations also provides learning experiences.

9. The rates of social change. There is always a danger that the possibilities of development are appraised from an excessively static conception of the social context. The pace of change is accelerating within contemporary Africa, both in terms of actual behavior and the values and other factors which influence behavior. It is important to appreciate the extent, direction and nature of change and how development and the factors conditioning it are constantly inter-
acting. There may be significant changes in the relative importance of kin-based groups as against voluntary associations, of the leaders emerging from modern forms of political and economic organization as against the older leaders of the more traditional society, of group as against individual control over land, or material goods as against social and leisure activities, etc. Thus failure to take into consideration such trends as the transformation of kin-based societies into societies based more on voluntary association may lead to unsuccessful attempts to innovate on the basis of extended kin and other groupings which are no longer functional in agricultural matters. On the other hand, the continued ability of corporate kin groups to expedite the exploitation of new land resources and certain cash crops in parts of Africa not only points up the ability of kin-based institutions to adjust to modern conditions but also serves notice against facile generalization. Because of differential rates of social change and the variety of African life ways, each situation requires careful analysis in terms of the whole range of potentially significant social and other variables.

We shall refer again to many of the factors and problems treated above. Their relevance to particular situations and particular problems will be brought out in greater detail as we proceed with a discussion of such subjects as incentives, labor and land, implements, agricultural extension and education, land tenure, etc. In the balance of this chapter we shall expand on at least some of them in the context of an examination of farmers' motivations or incentives.

**Farmer motivations**

The success of any particular agricultural scheme or improvements will inevitably depend on whether the farmers involved will respond to the prospective increase in income and will be prepared to make the extra effort that appears necessary. Discussions of this subject have often been characterized by sweeping generalizations or by preconceptions about the "laziness" of the "African," his failure to respond to "rational" or "economic" considerations, etc. We have been impressed by certain recurring characteristics of African farmers, but we would not claim that any views about these are in any sense universally valid under the wide variety of social and economic conditions obtaining in tropical Africa today. At best they can only be considered as hypotheses, the validity of which must be tested in any given situation.

**The concern for security**

For many Africans security is a more important consideration than the possibility of increasing income. This is reflected particularly by
continued insistence that the farm should produce all of the basic foodstuffs required by the family. Farm self-sufficiency is obviously particularly important in areas which have no very attractive cash crop alternatives, or which may be far from markets that provide a reliable and remunerative outlet for the sale of farm produce as well as a reliable place to buy needed foodstuffs in exchange. However, even in areas where commercial crops have been successfully introduced and considerable money has been earned from them for some time, production for the market still tends to be limited by the importance attached to basic subsistence crops. The reluctance, under these circumstances, to adopt the kind of specialization and exchange that would help to maximize income is attributable to a number of factors. One is presumably a continuing distrust of the market and its vicissitudes. Another may be the slowness of realizing the possibilities of alternative uses of land and labor under changing circumstances. However, one of the more important factors appears to be the duality of the household economy—the lack of a full identity of interests among men and women with respect both to production and to the expenditure of income. We have already noted that men tend to keep control over income from lucrative cash crops and that this gives women a continued interest in growing enough food to feed their families as well as an incentive to develop some cash income of their own. In some parts of Africa, notably West Africa, women have become very prominent in trading. Even where they are not active traders, they do have the right to sell some of the produce of the land. The practices governing this right to sell vary widely. While in one part of Sukumaland it was found that the women had the right to sell and use the income from surpluses of certain food crops, men had the sole right to the sales income from bulrush millet, rice and cassava. Usually women are entitled to sell the surpluses of cereals grown primarily as subsistence crops, or alternatively, the beer which they brew from such surpluses; and they may seek to increase the surplus of cereals so that they can brew or sell more beer. In Nigeria, income from the oil palm fruit was traditionally regarded as belonging to the man and that from the kernel, to the woman. With the introduction of "pioneer oil mills" which extracted the oil from both fruit and kernels, the man claimed a right to all of the income—a development which led women to demonstrate violently against the erection of new oil mills on several occasions. When their principal interest is in growing food for their families, women often begrudge the amount of time they are required to spend on cash crops which are the prerogatives of their husbands even though these in principle may yield the
highest returns to land or labor. They have hardly had the power to prevent the development of such crops, but they may well have slowed it up by their resistance. In more recent times the African males in some areas are showing a greater disposition to share their cash income more regularly with their wives, but a pooling of income and resources is still far from being achieved.

The attitude toward livestock

The concern for security seems largely responsible at bottom for the allegedly irrational and "noneconomic" behavior of many Africans with respect to livestock, particularly cattle. In considering this question we shall not comment on the problems and attitudes of the pure pastoralists who derive their entire livelihood from livestock. It is the attitude of peoples who have long settled down to farming but still appear to attach an inordinate importance to livestock that comes into question. Such people are often said to show a preference for large numbers of livestock strictly as a matter of prestige, as a means of cementing "social relationships," and "commanding others," including brides obtained through the transfer of cattle (the so-called "bride price"). It would be exaggerating to say that the role which livestock play in all African societies is fully understood or that it is entirely susceptible to intelligible explanation. Yet an increasing number of students and observers have come to the conclusion, which we share on the basis of our experience, that attitudes to livestock are prompted to a large extent by economic as well as social factors. For instance, the accumulation of livestock for payment of the "bride price" enables the adult male to obtain a wife who will till the land for the purpose of ensuring the family's basic food supply. The widespread reluctance to market cattle regularly may stem not so much from an emotional attachment to these animals as from a concept that cattle are a store of wealth or a savings account from which withdrawals are made.

Dr. John R. Raeburn, who has devoted considerable attention to farm economics in Africa, may have deliberately overstated this point for the sake of emphasis when he wrote as follows about the resistance of women to cash crops: "She may even cut down the coffee trees you have planted or, in Western Nigeria, keep making cassava flour and going to market with it to earn 1s.-2s. a day instead of helping to save you 5s. by weeding, picking and fermenting cocoa."

"Some Economic Aspects of African Agriculture," East African Economics Review, January 1959. Dr. Anne Martin also has observed in her study The Marketing of Minor Crops in Uganda (Department of Technical Co-operation, Overseas Research Publication, No. 1, London, Her Majesty's Stationery Office, 1963) that women sometimes not only resent their husband's working on cash crops because the latter compete for a limited labor supply, but even refuse to work on cash crops though these represent a more profitable use of family labor.
only for special ceremonial or social occasions or for emergency needs such as payments for education, etc., and which can be used, in the drier areas, to compensate for the consequences of crop failures. Thus many African farmers keeping livestock build up their herds as rapidly as possible during years of ample rainfall and good grazing conditions, only to reduce them or suffer a portion to perish in succeeding years of drought when grazing becomes insufficient to support the herds. Thus Allan writes: “These attitudes [toward cattle] have underlying economic motives, though they are obscured by the accretion of emotional and social values, and the motivating circumstances have changed in recent years. The flocks and herds of nomadic pastoralists were continually menaced, to a much greater extent than is generally the case today, by epidemic disease, drought and the depredations of human raiders and beasts of prey. There was no absolute security against complete disaster, and the depredations of human raiders and beasts of prey, but relative security lay in the maintenance of large numbers of animals, so that even after heavy loss enough might remain for subsistence and the rebuilding of herds.”

Such traditional attitudes can and do change. With increasing population pressure on land, the area available for grazing and browsing may have to be reduced progressively in favor of the cultivation of crops. The development of a reliable cash income or other means of satisfying the needs formerly met by traditional livestock practices may produce a significant alteration. This appears to be the case, for instance, of many Kikuyu farmers in Kenya who now have a secure source of income not only from new cash crops but also from the adoption of productive dairy cattle. No such change is evident, however, in the drier and lower areas of the Central Nyanza and Baringo Districts of Kenya where no secure and regular source of cash income had for the most part been found. In Sukumaland we observed that much of the income from the rapidly expanding cotton crop was being invested in cattle, but it is possible that in the longer run a steady and rising income from cotton will gradually diminish the reliance on cattle, particularly since cotton at times furnishes a good income in years of poor food harvests, thus serving as a compensating factor in the same way as livestock. In Basutoland one authority has reported—as we indeed noted in the productive

7 Belshaw suggests that cattle sales may be inversely correlated to cotton incomes also in Eastern Uganda. See D. G. R. Belshaw, The Level of Incentives; A Factor Limiting Agricultural Production in Uganda, a paper read at the Annual Conference of the Uganda Agricultural Association on September 16, 1963.
agricultural areas of Kenya—that the growing availability of other means of investing savings has diminished the incentive to accumulate wealth in the form of cattle.  

Income aspirations and target income concepts

Apart from the concern for security, limited income aspirations militate against the success of efforts to raise income. The income aspirations of peoples in Africa do, of course, differ widely, depending on the degree and length of their exposure to the market economy and its blandishments. It tends to be lowest for people who live in relative isolation and whose output is still almost entirely for subsistence. These are hardly aware of possible opportunities for increasing production or for using labor as a means of obtaining more than the bare essentials of life. In other words, they tend to regard production as relatively immutable. There may also be peoples who have a vague desire for more income but who, on the basis of discouraging past experiences, have a rather hopeless attitude toward obtaining it. Peoples of both kinds may still be found in tropical Africa, although their number is progressively decreasing. As an instance of the first kind we might cite the people remaining on the western escarpment of the Kerio River Valley in Kenya; of the latter, the Mossi in Upper Volta. Many of the Mossi farmers, for example, we found quite resigned simply because, living in an unpromising agricultural environment, they believed—and with some justification—that their production was so much at the mercy of poor soils and erratic, undependable rainfall as to be beyond human influence.

Vernon G. Sheddick has written: “Thus although it is to some extent true to say that the Basuto attitude to cattle is such as to be beyond the operation and the exercise of economic and utilitarian considerations, by and large they use and value this item of stock as the most useful and the most valuable form of personal possession. Having arrived at this conclusion it is now necessary to indicate that even this attitude is changing. People, once they have acquired their ploughing teams and the necessary marriage cattle for their sons, are now discovering other attractive ways of storing wealth. Whereas formerly a man almost unhesitatingly converted his accumulated profits and surpluses into cattle, he now invests in agricultural equipment which may be loaned on hire, stock and shares, banking accounts and even in farms and land outside Basutoland.” See Land Tenure in Basutoland (Colonial Research Studies, No. 13, London, Her Majesty’s Stationery Office, 1954, p. 104.)

In exceptional cases, as among the Lakeside Tonga of Malawi or the Nubians of Egypt and Sudan, such peoples may be able to achieve a comparatively high standard of living on the basis of income from labor migration.

Over much of rural tropical Africa one still encounters what has been called the "target income" mentality. This is not to deny that income expectations among rural Africans have not risen and are not rising in many areas. It simply means that at some point in time there is a tendency to regard so much income as enough and to regard additional income as not worth the extra effort required to obtain it. The target can and does move over time, but at any one time it tends to be more or less fixed. In Sukumaland, for example, we heard and saw evidence that cotton farmers in some areas were leaving part of their cotton unpicked, or were leaving their cotton unpicked until all the bolls were mature even though this meant a deterioration in quality and lower incomes. In Rwanda and Burundi it has been noted that when coffee prices rise or the coffee harvest is abundant farmers tend to leave a portion of the coffee berries on the trees. We would not suggest, however, that we have found firm evidence of the widespread operation of what economists call the "backward-sloping supply curve," i.e., a tendency for producers to curtail their supplies to the market when prices rise. There may be individual cases of such behavior, but it is unlikely that they are very widespread and they may well be obscured by the action of new producers entering the market for the first time in response to higher prices.

The target income concept is by no means confined to African peoples who have had only limited contact with the market economy. In some degree it obtains also among more sophisticated peoples who have long enjoyed a (for them) considerable amount of money income, such as the Africans carrying on profitable farming in the Kenya highlands, or the people who have, for a still longer time, derived much income from coffee and cocoa in West Africa. In such instances there may be more flexibility in the income target. In these cases also the limited aspirations for material goods may be primarily reflected by a tendency to use far more hired labor than

12 Yudelman reports interviewing 50 casual migratory workers in Rhodesia about their reaction to a hypothetical doubling of their wages. Interestingly enough, 20 percent of the higher-paid group and 46 percent of the lower-paid group said they would return sooner to their homes; while 60 percent of the first and 30 percent of the latter group thought it would not affect the duration of their wage employment; the balance were undecided. See M. Yudelman, Africans on the Land (Cambridge, Mass., Harvard University Press, 1964), p. 98.
13 In this connection Yudelman observes (ibid., p. 174): "Even in parts of Southern, Central and East Africa where export crops are grown, many producers prefer to leave resources unemployed rather than to increase their labor inputs."
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is really necessary. Under such conditions the employer considers labor not so much as a means of production, but rather as a means of sparing himself some of the drudgery of farm labor or of maintaining and increasing the opportunities for engaging in social activities and cultivating social ties, which in African cultures are generally valued rather highly.

Responses to income opportunities

Spending habits and value concepts

No agricultural program or project should, of course, be launched unless there is reasonable assurance that farmers will respond to the additional income opportunities it offers. The availability of unutilized family labor which can in principle be transformed into income is not in itself a guarantee that people will respond to such new opportunities. It is necessary to find out how much people are interested in more income. For this purpose it is important to know how rapidly people are becoming cash conscious and how total consumption and its composition are developing as a reflection of changing values. Studies of income and consumption in rural Africa are unfortunately still quite rare, so that primary reliance must be placed on impressions obtained through rather hasty field studies. Useful impressions of the trend and direction of consumption and developing needs can fortunately often be obtained from the testimony of merchants, local government personnel and the farmers themselves. Where evidence indicates that incomes and expenditures have been rising steadily and consistently, there will obviously be a prima facie case for believing that people will respond to new income opportunities. The response is likely to be much more uncertain when people have not been exposed to cash income for a long time and when the expenditure of this income has not produced a standard of living which the whole farm family has an interest in maintaining and raising. In this connection the type of consumer expenditures and the beneficiaries of such expenditures may be very revealing. When increases in income are devoted largely to the purchase of alcohol or articles of “conspicuous consumption,” such as radios and items of this nature, this usually indicates that a regular pattern or standard of consumption and a strong desire for more income have not yet developed. The same conclusion may be

14 For instance, Yudelman found, in the interviews with migratory workers in Rhodesia which have already been mentioned, that “Their income goals are clearly related to the length of time they have been exposed to their income levels.” (Ibid., p. 96.)
drawn when a significant part of additional income is used to buy cattle, reflecting a desire for greater security and, perhaps, prestige. Such conditions are likely to obtain in societies where there is no great confidence in the stability of any past rise in income or where consumption is dictated largely by the whims and desires of the head of the family who considers cash income his personal prerogative without much regard for the needs of his family. On the other hand, where people have become accustomed to a certain level of income and where income tends to be spent increasingly for the benefit of the family as a whole, one is likely to find a stronger response to opportunities to raise what has become a true standard of living. For example, increasing emphasis on education or on improvements in housing is usually indicative of rising family income aspirations which the women as well as the men can share. In Kenya, for instance, we noted that the desire for education and the corresponding need to earn money for school fees has operated as a strong incentive in many areas.

The certainty and immediacy of income

Response to new programs and projects will be determined not only by income aspirations, but by the degree of certainty, the time incidence and the extent of the prospective increase in income. Experience tends to demonstrate that farmers are often not easily convinced that an increase in income will be permanent. This is particularly true of the many farmers who live in areas where the hazards of climate expose them to marked fluctuations in production and income. Under those conditions, it has to be demonstrated that the promised rise in income will in fact recur each year and will be more than sufficient to pay for all the required inputs and compensate the farmer for any extra effort involved. In this connection it should be stressed that average increases in income are rather meaningless to the African farmer. For example, he is unlikely to be interested in fertilizers that yield a good average return when in several years they may produce no return at all, or in the adoption of new varieties which do not outyield old varieties every year.

The limited time horizon of the farmer is a factor that must be taken into account in assessing response to innovations. Time horizons are susceptible of extension through experience and edu-

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18 In this connection it is interesting to note that a budget survey carried out among farmers in Ruanda-Urundi during 1955/56 showed that income elasticity of demand (i.e., the proportion by which demand rose in relation to increases in income) for livestock was 1.60 and that for foreign beer, 2.08. See Leurquin, *Le niveau de vie des populations rurales du Ruanda-Urundi*, p. 313.
cation, but for many Africans such horizons are still very restricted. Generally there is a marked preference for measures that yield immediate benefits and a tendency to discount rather heavily longer-term benefits, particularly if these are in themselves uncertain or difficult to calculate. Thus campaigns whose sole aim has been to arrest soil erosion and to bring about soil conservation have seldom, if ever, enlisted the enduring interest of African farmers; but when soil conservation has been an integral part of a wider program which has included the introduction of a profitable cash crop, it has often found widespread acceptance. Similarly, efforts to control grazing have often failed to elicit much response, partly because their effect has not been immediate or clearly discernible. Yet farmers have often been willing to wait a number of years for returns from such tree crops as coffee and cocoa. In such cases, however, these crops have been strikingly remunerative and the farmers have obviously seen impressive demonstrations of their profitability on the land of pioneer African farmers or on that of European farmers or plantations in their midst.

*The decisive character of striking income increases*

This leads to a consideration of the third factor in responses, namely, the size or extent of the prospective increase in income. The amount of additional income (net of the cost of all inputs except for additional family labor) that will be required to elicit necessary responses will vary considerably depending on the situation. Experience indicates, however, that under most conditions the increase in income must be rather striking. There are at least three reasons why small additions to output have not been very attractive. One is that such small increases are difficult to dissociate from the adventitious effects of climatic changes. In others words, the benefits may not be clear-cut. Another is that any innovation is likely to involve some risk; and the farmer is disinclined to assume uncertain risks for the sake of small potential gains. Rather small increases in income may also appear unattractive in relation to other and still not fully exhausted opportunities to earn income such as by wage labor. But, above all, there is a tendency, as we have already emphasized, to put a high value on the leisure or social activities that the farmer may have to forego in a quest for more output and income. We have the impression that in many cases farmers still want a return for additional labor that is higher or at least equal to that for labor that they are already expending. We would admit, however, that the marginal returns that are likely to be acceptable to farmers under various conditions should be the subject of much more study.
Much evidence can be marshalled in support of the general proposition advanced in the preceding paragraph. Crops which have made the greatest advance over recent decades are also those which are strikingly profitable, such as cocoa and robusta coffee in West Africa and both arabica and robusta coffee and tea in East and Central Africa. Extension of these crops has often been stimulated by price increases which made them appear even more attractive. In the Ivory Coast, for example, the bulk of coffee was planted in the six-year period following 1952 which was marked by rising prices. In Rwanda and Burundi, where people lived almost entirely from subsistence farming supplemented by some cash income from labor migration, the Belgians first required farmers to grow arabica coffee, but after some time the rise in prices proved to be a sufficient incentive to grow coffee, particularly since it afforded a much higher return to labor than migratory employment for wages. In Kenya the planting of arabica coffee by Africans was probably also stimulated by rising prices in the '50's, but the rapid increase in coffee areas continued while prices were falling simply because coffee still provided an income far beyond that of any alternative crop. On Mount Elgon in Uganda the planting of arabica coffee continued to increase in the inter-War period despite a substantial drop in prices from 1928 to 1933, but the greatest expansion occurred after 1947 under the impulse of the rise in prices from that year until 1954.

Almost everywhere we found that the prospect of modest increases in output had not stimulated much interest. We have already alluded to the little appeal which soil conservation efforts and grazing control schemes have had. In the Mossi country of Upper Volta and the Bokoro region of the Chad we noted that extension programs were not making much progress, largely because the improvements that they were propagating did not seem to offer a prospect of significant improvement. In Kenya very little interest has been shown in the slow increase of productivity that can be achieved by upgrading native livestock, but European types of cattle, with their strikingly superior yields, have been readily adopted by many Africans in the higher areas of the country even though this involved rather radical changes in traditional animal husbandry. Whereas in some areas of Kenya profitable opportunities for modern dairying and the production of coffee, tea, pyrethrum and potatoes have brought about great changes in agriculture, little progress has been made in various parts of Machakos and Central Nyanza Districts where opportunities were much less attractive, particularly by com-

16 Ibid., p. 101.
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parison with those afforded by labor migration. In Burundi we found that people had eventually taken to the production of coffee, cotton and rice since these provided substantial cash income, but that response to a technically well-conceived program to improve agriculture and animal husbandry in the high, cold region of Kisozi had been disappointing, largely because there was no possibility of an immediate and significant increase in cash income.

Confronted by alternative opportunities Africans often display a keen ability to choose the least burdensome (in terms of labor) way of attaining the income they want, or, to put it in other words, the ones likely to give them the highest return for the amount of work they are willing to do. In the Nyeri District of Kenya, for example, farm economic surveys indicated that this accounted for the expansion and popularity of coffee, tea and dairying as compared with pyrethrum, pig-keeping and pineapples, which the extension service had also been encouraging. Similar farm surveys in Sukumaland have pointed up the farmer's preoccupation with the selection of types of activities and methods of production which yield the highest immediate return to the effort he is prepared to make. In Nigeria the laborious gathering of the fruit of wild oil palms has become progressively less attractive in relation to alternatives, particularly in Western Nigeria where better paid and less arduous employment opportunities are available in cocoa and rubber production. Such examples of considerable discrimination among various alternative uses of labor could be multiplied many times.

A few additional remarks should be made about the magnitude of incentives required to attract settlers to new irrigation or other organized land colonization schemes. The available evidence indicates that the incentive in such cases may well have to be significantly larger than that needed to induce acceptance of innovations on land where farmers are already established and are accustomed to live. Resettlement often involves more or less unwelcome changes—the severance of social ties which are valued, a different climate, adoption of new and unfamiliar methods of production, and, above all, acceptance of some degree of discipline under the supervision of a strange management. People are generally reluctant to make the sacrifices involved unless they are experiencing serious difficulties in making a living and they have reason to expect a secure and substantial rise in income under the new conditions. Many settlement schemes started in tropical Africa, primarily after the last World War, failed because this condition was not met. In some cases it was necessary to recruit settlers virtually by force. The Office du Niger, the irrigation scheme in Mali, evidently offered most actual or po-
tential settlers opportunities to earn a higher income, but the income apparently never proved to be sufficiently superior to attract and keep an adequate number of settlers. On the other hand, the Gezira Scheme in the Sudan quickly demonstrated its capacity to produce an income so superior to the level obtaining in any of the neighboring areas that it has not been difficult, at least up to the present, to recruit sufficient settlers both for the original project and its successive extensions. On a much smaller rice growing scheme in Kenya—Mwea-Tebere—the situation has been the same; and incomes there have been high enough that people were willing to put up with an unfamiliar village pattern of settlement.

Some general observations

We have pointed out earlier that the natural environment over much of tropical Africa is not very favorable to the development of remunerative agriculture and that research and experimentation have failed to a large extent in developing practicable and profitable innovations. On the other hand, experience does demonstrate that many Africans, once they emerge from their subsistence economy and have been exposed to the attractions of money income for some time, respond readily to demonstrated profit opportunities. The receptivity of the African to change is illustrated by the rather rapid development of sub-Saharan Africa during this century. The production and export of "cash crops" of various types have increased very impressively. African farmers in many areas have been drawn into the exchange economy at a rapid rate. While certain institutional factors inhibit change, an increasing but still small number of Africans have shown a disposition to free themselves from traditional restraints and have demonstrated a capacity for rapid change when exposed to income opportunities in a new environment.

Allan has remarked: “The extraordinary development of the production of cash crops by African cultivators, mainly within the last forty years, is something unprecedented in colonial history.” (The African Husbandman, p. 346.) Within the most recent decade, production of a number of crops in Africa has risen as follows in thousands of tons (the average of 1948/49 to 1952/53 as compared with the average of 1958/59 to 1962/63): cocoa beans, from 500 to 750, or by 50 percent; coffee, from 280 to 750, or by 168 percent; tea, from 19 to 49, or by 157 percent; cotton (excluding the UAR), from 304 to 455, or by 50 percent; groundnuts in shell (excluding South Africa), from 2137 to 3057, or by 73 percent; and paddy (excluding the UAR), from 2387 to 2971, or by 24 percent. On the other hand, for reasons already indicated above, the output of palm oil and palm kernels rose only about 10 percent. See “The Food and Agricultural Situation in Africa—A Five-Year Review.” Agricultural Economics Bulletin for Africa, No. 5, April 1964.

On this subject see particularly our case studies on Kenya. An instance of very rapid change is that of the Elgeyo who moved from the Kerio River Valley escarpment to the plateau where they quickly took advantage of opportunities to grow potatoes, wheat and pyrethrum and to engage in modern dairying.
also shows, as we shall later elaborate, that institutional obstacles to change tend to diminish when attractive economic opportunities appear. We have noted, too, that Africans who are no longer dominated solely by a concern for security frequently tend to take a very pragmatic view of farming. While generally anxious to maintain some link to the land, they are not necessarily wedded to agriculture as the only means of livelihood. If they have the opportunity, they may move readily from farming to other pursuits, including wage employment, trade and other occupations, and again back to agriculture, as their own interests dictate. This we found to be particularly true of some areas in East Africa. There, we noted repeatedly that profits of farming had been used to open up shops or some other business and that, in turn, savings from other businesses or occupations were invested in farming. Thus farming comes to be regarded as a business rather than simply a “way of life.” This tendency of the evolving African to consider farming as a business undoubtedly has certain disadvantages. In such cases the shift in interest is often too much dominated by considerations of short-term profit in line with the limited “time horizon” to which we have already referred. Thus there is at times a tendency to turn too rapidly from one thing to another in the ceaseless pursuit of “easy” ways to make money quickly. Similarly, there is an inclination to look upon the soil as something to be exploited for short-term profit rather than as a resource which must be carefully managed in the longer-run interest. This short-term view has produced in many areas serious problems of soil erosion and deterioration of grazing with which agricultural officials and range management experts have been unable to cope effectively.

**Prices and incentives**

*The response to prices—general*

The above discussion of the factors conditioning farmers’ responses to income opportunities must be complemented by a few observations on the relationship of prices and subsidies to incentives. We have already remarked that there is not much evidence of the exist-

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19 While we noted this particularly in Kenya, others have observed the same trend in other parts of Africa where people have become accustomed to the money economy. Commenting on trends in Basutoland, for instance, Sheddick, writing more than a decade ago, characterized as most significant “the emergence of new agricultural classes; semi-peasants who combine with the activities of peasantry, business enterprises, wage earning and salaried administrative employment; and the capitalist farmer who, while not necessarily holding much land directly, receives produce from a considerable acreage as a return for the employment of his capital resources.” (Sheddick, *Land Tenure in Basutoland*, pp. 184–185.)
ance of a "backward-sloping supply curve" and that, on the contrary, rising prices have on occasion provided a fillip to the development of certain cash crops. Yet this does not mean that a rise in prices automatically leads African farmers to increase their output. As already indicated, many areas and societies in Africa are still to some degree characterized by "target income" mentalities. When some minimum income has been reached under these conditions it may well require substantially higher prices to elicit the effort required for additional output and marketings.

In the absence of detailed studies it is difficult to determine under varying conditions what prices are "remunerative" in the eyes of the farmer or how he responds to price changes. In general the response to prices tends to vary with the degree and length of exposure to the market and certain levels of income and consumption as well as with the type of product. People who have long been exposed to the market and derive considerable income from it will respond to prices in much the same way as those in fully developed market economies, at least with respect to those commodities they produce primarily for the market.

The reaction to a drop in prices can be markedly different. Farmers who have only recently entered the market economy and have not yet formed consumption habits on the basis of the money income they have received may well be profoundly discouraged by a sharp drop in prices or, conversely, a significant increase in the money costs of certain requisites of production. On the other hand, where people have become accustomed to certain levels of income and consumption, a drop in prices may even spur them to greater efforts in order to maintain their income standard. Alternatively, a decline in price may be quite compatible with continued expansion in output when even at lower prices the profitability of a new crop or any other innovation is substantially greater than any alternative.

**The response in the case of subsistence crops and livestock**

The response of production and sales to prices tends to be negligible in the case of crops still grown primarily for subsistence and small in the case of cattle. Wherever possible, African farmers tend to cultivate enough subsistence crops so that their own requirements are covered even when climatic conditions are unfavorable. Marketable surpluses are generated, but the amount fluctuates sharply from year to year and is little, if at all, influenced by prices.\(^{20}\) This

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do not mean, of course, that the marketing of such adventitious surpluses is insensitive to prices. African women, for example, will often go very far to sell their surplus produce at the highest possible price largely because the small proceeds from such sales represent the only type of income which they personally control. Yet this kind of response to price obviously has little effect on the allocation of productive resources, that is, land and labor. The line of demarcation between "subsistence" and "cash" crops may not, of course, be very sharp; when an increasing portion of a crop originally grown for subsistence is marketed, its production is progressively more determined by prices.

Cattle in Africa do not usually have the character of a regularly marketed "cash crop." When cattle are an important element in security, in meeting emergency needs and in cementing social ties, they are not marketed regularly but in response to fluctuating requirements dictated by occasional needs and by grazing conditions. Thus, if grazing is good it will usually take a very substantial rise in prices to persuade people to increase their cattle sales in the face of the more fundamental urge to build up their herds. Similarly, during years of drought the volume of livestock sold (or the number of hides marketed as the result of "natural deaths") tends to expand regardless of price levels. Frequently, the development of facilities for marketing livestock, such as auction markets, controlled livestock routes and abattoirs, generally has had a disappointingly slow effect. There may be a gradually rising response to such facilities but only as and when a need for regular money income is increasingly felt and this need can be fully met only through the sale of cattle.

p. 177. As the last two authors have pointed out, boards which were established to market the commercial maize production of European farmers in a number of African countries (e.g., former Northern Rhodesia and Southern Rhodesia) have often been embarrassed by the large but widely fluctuating amount of maize they have had to buy from African subsistence farmers. In Kenya, however, the fluctuation in the amounts of maize sold by African farmers is not very much greater than that marketed by European farmers, apparently because a considerable number of Africans grow maize in large part for the purpose of earning a cash income.


22 In Bechuanaland where little cropping is possible owing to the scanty rainfall and livestock is virtually the only source of cash income, African herders have gradually responded to the improvement in marketing facilities resulting from the establishment of the Lobatsi Abattoir in 1954. This abattoir, which was given the exclusive right to export slaughter cattle and beef, has managed to increase its cattle purchases from an annual level of about 70,000 head to around 110,000 head.
a developing money economy one will often find, at one and the same time, livestock owners who are progressively more responsive to market prices and opportunities, as well as livestock owners who are hardly influenced by market considerations.\(^2\)

*Price and subsidy policies*

The extent to which prices and subsidies can or should be used or manipulated to increase incentives is often an important issue. The notion that the African farmer must, above all, be assured stable prices is very widespread and inspires the policies of many marketing boards found throughout Africa. It is often believed, too, that prices of new agricultural products or of new requisites of production such as fertilizers, insecticides or implements must be subsidized in order to encourage innovation. Experience indicates that the wisdom or efficacy of such measures cannot be determined without distinguishing between different types of situations.

When farmers are being weaned from what is basically a subsistence economy and encouraged to produce for the market, stability in the price of marketed products and in the cost of required inputs may well be essential to the achievement of the objective. At this stage, it may be necessary to develop confidence in the dependability of the market and the reliability of the rate of return from any innovation. During this initial phase of development people tend to be quickly discouraged by changes in prices which have an adverse effect on their returns and which they find incomprehensible. In Upper Volta, for example, we noted one instance where farmers were thoroughly confused and presumably disheartened by a change in fertilizer subsidies which suddenly required them to pay more for a substantially smaller quantity of fertilizer.

A good case can also be made, at least in principle, for some subsidy of agricultural prices or inputs in order to stimulate the adoption of new methods or new crops in the early stages of development. We have already pointed out that substantial incentives or increases in income are often necessary, particularly when people

\(^2\) Yudelman interviewed 50 livestock owners in Southern Rhodesia and found that 30 of them deemed a 25 percent increase in prices an insufficient inducement to sell their “surplus cattle” (defined as the number in excess of those required for plowing); and half of the remaining 20 who were prepared to sell said that the price increase would have to be greater than 15 percent. He also noted that when livestock prices rose markedly following the abandonment of price fixing by the Government of Southern Rhodesia in 1958 there was a sudden upsurge of sales. However, this increase in sales was not maintained even when prices rose still further, apparently because there were only a limited number of farmers whose sales reacted to price changes. See *Africans on the Land*, p. 100.
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are very much wedded to security, are disinclined to take risks and have not yet become used to any significant amount of cash income. In such cases three conditions have to be met. First, the subsidies must be large enough to affect the initial “rewards” of innovation significantly in the eyes of the farmer. Secondly, in view of their cost they must be discontinued as soon as the conditions which first justified them no longer obtain—for example, when the innovations have been accepted and farmers have become used to enjoying the resulting increase in production. Thirdly, research and field trials must have demonstrated that farmers are in the end likely to find the new crops or practices rewarding even after the subsidies have been dropped. For example, in Mali, where we studied the efforts to promote higher-yielding cotton varieties and associated improvements in agricultural practices in dry farming areas, temporary subsidies may have been useful in accelerating appropriate responses by farmers. Here, there was evidence that the net increase in output that farmers would experience was sufficiently large to be attractive eventually even without subsidies. On the other hand, in the Mossi country of Upper Volta, where the use of fertilizers was being subsidized, there was little assurance that the value of the increased output in relation to costs would, in the absence of subsidies, ever be considered by farmers as a sufficient inducement.

Under some conditions changes in prices, whether of farm products or of the means of production, may well hasten innovation. We have already pointed out that in some cases rising prices have accelerated the adoption of new crops. Where farmers have become accustomed to certain income standards, any threat to such standards from a drop in farm prices or a rise in costs may lead them to explore more actively ways and means to improve the efficiency of their farming in an effort to maintain or even increase their net incomes. Thus, they may find it necessary to use labor more efficiently or become more receptive to increases in net yields that can be obtained through the use of fertilizers or insecticides and that they have previously neglected simply because they could earn adequate incomes without them.

Although discriminating use of price incentives and subsidies can at times be justified, practical considerations dictate considerable caution. There is a serious danger in fostering the illusion that prices can be fixed by governments at will. In our many talks with African extension personnel and farmers we encountered widespread ignor-

24 See, for instance, Belshaw, The Level of Incentives: A Factor Limiting Agricultural Production In Uganda.
ance of the operations of the market and a naive confidence in the ability of governments to control market forces. Since we could seldom escape some identification with such governments, we were asked on many occasions why we did not raise prices of this or that farm product or lower the cost of some requisite of production! Governments have helped to propagate this naive faith through many and long-continued, but often very costly, interventions in the market. Under such conditions price fixing tends to become a permanent feature irrespective of its repercussions on government finances or on the competitive position of the affected products in the world market. In many cases price support or stabilization is thus being continued long after the conditions which may originally have justified it have ceased to exist.
CHAPTER FIVE

LABOR, LAND, INTENSIFICATION AND FARM ECONOMICS

In the last chapter we discussed various factors affecting the incentives of African farmers. In this chapter we shall take up the availability of two factors of production—labor and land—as they affect the feasibility of incorporating new methods and new crops into African farming. We shall emphasize the importance of labor as a constraint on production and then examine, in the following chapter, the possibility of modifying this constraint through the adoption or greater use of implements and machinery.

**Failure to recognize labor constraints**

While the vital role of labor supply in African agriculture is gradually receiving more attention, inadequate recognition of its importance has been a prominent cause of failure of many past efforts to increase output. Efforts to get farmers to plant earlier have repeatedly failed because there was not enough labor available at the recommended time and no provision had been made to introduce implements to relieve the labor bottleneck. New settlement or irrigation projects have often proved disappointing because their labor requirements were ignored or the demographic pressures in the regions which were supposed to furnish the settlers or labor were overestimated. Again and again attempts have been made to “intensify” output—i.e., to increase yields per unit of area by additional “inputs,” including more labor—under conditions where farmers, not troubled by a shortage of land, obviously thought that “extensive” production was a more effective way to increase their total income. In most of these cases there was a failure to understand the relative scarcity of labor and land or to grasp the importance of maximizing returns to the scarcer factor. Although conditions vary widely and may be changing fairly rapidly, land has not in the past been the scarce factor of production over much of Africa. In the eyes
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of the farmer at least, labor has been the scarcer factor. He therefore tends to be primarily interested in the return to the labor he is willing to put in. His focus on returns to labor is not always at variance with that of raising the returns to, or the yield on, land, but the possibility of a conflict must always be kept in mind.

The case of the Office du Niger

Failure to recognize the crucial relationship of land and labor tends to have particularly serious consequences when heavy investments are made in irrigation or land colonization schemes. These can be justified only on the basis of a rather high output per unit of area which in turn cannot be achieved unless it is possible to mobilize the requisite amount of labor, suitably supplemented by the use of machinery.

A case in point is the Office du Niger, to which reference has already been made. This rice- and cotton-growing irrigation scheme has suffered from a considerable number of deficiencies, but one of the most critical has undoubtedly been its inability to attract enough settlers and laborers. Launched during the inter-War period in a sparsely populated area of what is now Mali, this scheme was expected to draw on a much larger area of French-administered Africa for its settlers. This expectation, however, was never realized even before the constituent parts of this larger region became independent. With the shortage of manpower, the maximum area put under cultivation—50,000 hectares—has fallen far short of the original goal, and the yields attained have generally not been sufficient to provide both an attractive income for the settlers and to cover the management and investment costs of the scheme.¹

To compensate for an insufficient supply of manpower, the Office du Niger has had to mechanize not only land levelling, which is so essential to proper irrigation and drainage, but also much of the land preparation, and such mechanization has proved very expensive in an area which is almost 1,000 miles from the nearest seaport. To raise yields to more satisfactory levels the management has tried to introduce new methods of cultivating cotton and to induce farmers in the purely rice-growing areas to shift from direct sowing to transplanting. However, the settlers have not generally found the extra labor involved in transplanting rice rewarding and attractive; and the widespread adoption of transplanting would in any event entail a curtailment of the area per settler and thus neces-

sitate the recruitment of more settlers. The intensification of cotton production has had somewhat greater success, partly because many of the "additional inputs" involved, such as mechanical ridging and aerial spraying, are contributed by the management and do not therefore involve the settler in additional labor. Even so, the extra labor that is required for more careful tending of the crop and, above all, for the picking of cotton, has tended to produce a contraction of the area cropped by each settler.

The wisdom of further large investment in the Office du Niger may be particularly questioned today when the scheme must be viewed solely within the context of Mali, a country which does not on the whole suffer from serious demographic pressures. In fact, under the prevailing distribution of land and population, it would appear advisable to avoid costly investments in large agricultural schemes and to exhaust first of all the less expensive ways of improving production in areas which are already being farmed. Attractive alternatives are available. Over the last decade, for example, a French company under contract with the Government has been markedly successful in encouraging the cultivation of cotton in the dry farming areas of the country, thus providing a growing number of farmers with attractive income opportunities at little cost. Moreover, in the valleys of the Niger River and its tributaries, there are many low-lying areas, ranging from a few hundred to a few thousand hectares, which can be developed for rice cultivation by establishing some degree of control over their inundation by the flood waters of the river. With only a very modest investment in control structures and the construction of dikes or levees, and small annual maintenance costs equivalent to perhaps 75 kilograms of rice per hectare, farmers can be enabled to produce about one ton of rice per hectare as compared with an average of 1.4 tons in the Office du Niger. The cost of developing these areas has in the past been no more than 15,000 to 20,000 Mali francs (ca. $60 to $80) per hectare, and can even be reduced to a lower figure when the farmers that will benefit contribute their labor free of charge in return for an allocation of land. On the other hand, the development of every additional hectare in the Office du Niger costs at least 250,000 francs (ca. $1,000). The potential for developing such small rice schemes has by no means

2 See our case study, "Mali: The Development of Peasant Cotton Production by the CFDT" (Compagnie Française pour le Développement des Fibres Textiles in the Mali Republic), in Vol. 2.

3 In 1957, for example, 18,128 tons of paddy were produced on the 16,459 hectares cultivated on 12 such schemes. See J. Deret, Considérations sur la riziculture au Soudan français (April 1958, mimeographed).
been exhausted in Mali. In 1963, for instance, we were informed that in the Ségou region alone 40,000 hectares could still be developed, in addition to the 11,000 hectares that had already been included in schemes. The United Nations Development Programme and FAO are now, in fact, devising ways of developing this potential.

The difficulty experienced by the Office du Niger in persuading settlers to transplant rice is not unique. In the Lake Alaotra area of Malagasy only about 12 percent of the area cropped to rice is transplanted, and that primarily by farmers who have considerably less land than others. There, the average family who has 3 to 4 hectares (7.4 to 9.9 acres) of rice land has found it easier to continue the practice of direct sowing. On the other hand, in the Mwea-Tebere irrigation scheme in Kenya it has proved possible to insist on transplanting, evidently because each tenant or settler family gets only four acres of rice and is also able, owing to the population density in surrounding areas, to hire such extra labor as may be required for transplanting or harvesting.

The profitability of extensive methods of cultivation

It is noteworthy that many of the conspicuously successful increases in production in tropical Africa have been achieved through extensive rather than intensive production techniques. This is true, for example, of the expansion of robusta coffee in Uganda, of cocoa and robusta coffee in the Ivory Coast, of cotton in Uganda, Tanzania and Northern Nigeria, etc. These and similar experiences demonstrate that where land is relatively plentiful in relation to population, the extensive cultivation that farmers have tended to prefer has in fact given them a better return for labor expended.

The Case of Ivory Coast Coffee and Cocoa. A conspicuous example is the Ivory Coast, where robusta coffee and cocoa production expanded rapidly over the last three decades, reaching respectively 254,500 and 97,200 tons in 1963. However, the low yields per hectare, averaging around 300 kg. for coffee and 250 kg. for cocoa, have been deplored by many agricultural experts. Traditional practices have indeed not been conducive to high yields. Usually patches of forest land have been partially cleared; seedlings have then been planted; and among them some food crops have generally been grown in the first few years. Seedlings have normally been left to grow amid the bush with little or no care until the first harvest. Very little labor has been expended on pruning, weeding and keeping the

surrounding bush cut back. In fact, the growing of coffee and cocoa might be said to be a type of "bush cultivation."

After the trees mature the labor expended annually on looking after and harvesting the crop has amounted to only about 35 man-days per hectare for cocoa and 50 to 70 for coffee. Trials and experiments have indicated that with more careful pruning, weeding and bush control, yields could be doubled. However, as a minimum such practices entail a doubling of the recurring annual labor input once the higher yields are achieved; and when account is also taken of the extra labor required in preceding years (either when the trees are still not bearing or when old plantings are in process of rehabilitation), the marginal return to labor is likely to be less than the average return. At best, farmers have not seen any advantage in increasing their yields as long as they could push into the forest and clear a little more land for additional coffee or cocoa production.

The advantage of the latter has in fact been enhanced by two additional factors. The first has been the possibility of entrusting the care and harvesting of such new plantings to immigrant labor on a sharecropping basis which generally gives the laborer two-thirds of the harvest. Thus the farmer could get 100 kg. of coffee with virtually no expenditure of labor by himself. The second has been that the opening of new land has given the farmer the opportunity, under customary law, to acquire for himself and his heirs rights to land which provide future security.

The experience in the Ivory Coast is borne out by a survey of

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8 In a sample survey conducted in 1955/56 in the Bongouanou subdivision of Dimbokro District in the southern part of the Ivory Coast, it was found, after grouping cocoa and coffee plantings by size, that those which had the largest area per active worker also had the largest output per active worker. See Enquête nutrition—niveau de vie, subdivision de Bongouanou, 1955-56 (Conseil Supérieur des Recherches Sociologiques Outre-Mer, Service de la Statistique et de la Mécanographie, Paris, 1958).

6 The rise in wages and growing shortage of labor are reported to have caused the abandonment of a number of French coffee plantations which apparently could not make a profit on the basis of the labor-intensive methods they employed.

7 This sharecropping practice prevails, above all, in the lower part of the Ivory Coast, where the sharecropper is given two-thirds of the harvest if he has done all the work, including that of planting, and one-third if he is responsible only for maintenance and harvesting. See Claude Meillassoux, Anthropologie économique des Gouro de Côte d'Ivoire (Paris, Mouton & Co., 1964), p. 343.

8 Polly Hill has traced a somewhat similar movement of various peoples in Ghana into the sparsely inhabited forest belt for the purpose of acquiring cocoa land. There, the land was acquired not through occupation and clearing, but through purchase from chiefs by groups formed on the basis of either residential or kinship ties. The land was then divided among members of the group for cultivation. See Polly Hill, The Migrant Cocoa Farmers of Southern Ghana: A Study in Rural Capitalism (Cambridge, Cambridge University Press, 1963).
cocoa farmers in Western Nigeria carried out in 1951/52. An examination of yields on 61 farms of varying sizes indicated that the volume of output per labor hour on the larger farms, where less labor was used per acre, was higher than on the smaller holdings. While yields rose with additional labor inputs per acre, the increase was proportionately less. In other words, labor showed diminishing marginal returns. This led to higher expenditures on labor and higher costs of production per hundred weight.

The Case of Sukumaland. The development of Sukumaland in Tanzania over recent decades provides another example of the failure to recognize the implications of man/land ratios for methods of cultivation. For a long time government authorities pursued a development program which featured, on the one hand, efforts to intensify production on existing farm land and, on the other hand, steps to open up, by bush clearing, provision of water supplies, etc., additional land for grazing and cultivation. These two goals were largely incompatible under Sukumaland conditions. Not only did new opportunities for acquiring land reduce pressures to raise the productivity of land already used, but certain aspects of Sukuma social organization, reinforced by certain values, encouraged population mobility and expansion. Thus the movement to new land was encouraged by the custom of leaving land to the senior son alone, as well as by a loosely structured kinship system and a proliferation of associations which could be used by pioneer farmers for agricultural purposes.

Moreover, the Sukuma revealed themselves quite adept at devising methods of growing cotton that gave them the minimum cash income they wanted with the least expenditure of effort. On the so-called hillsands they cultivated cotton on ridges. Here the Department of Agriculture sought to persuade and even to enforce the practice of tie-ridging. It had been experimentally demonstrated that tie-ridging could on the average increase cotton yields significantly by conserving and storing water from the early rains and thus making it possible for cotton seedlings to survive more easily the dry period which often occurred in February after the first rains.

9 R. Galetti, K. D. S. Baldwin and I. O. Dina, Nigerian Cocoa Farmers; an Economic Survey of Yoruba Cocoa Farming Families (published for the Cocoa Marketing Board, by the Oxford University Press, London, 1956), pp. 308 and 313. It is interesting to note that the survey reached the same conclusion with respect to food crops. (See pp. 325-326.)

10 Ibid., p. 381. Where labor input was only 60 hours per acre, the cost of production per cwt. of cocoa was Sh 22.4; but it rose with successive increments in labor utilization, reaching Sh 71.2 when 400 hours of labor were employed per acre.
Tie-ridging, however, was laborious and had to be done when the farmer tended already to be fully occupied. Once enforcement of this practice was abandoned, most farmers quickly abandoned it, generally devoting the time thus saved to an expansion of the area under cultivation. In fact, a farm economic survey subsequently undertaken has indicated that extension of the cropped area probably gives the farmer a higher aggregate return for his labor.

Elsewhere, where ox-plowing was almost universally practiced and population density was relatively low, Sukuma farmers found a different method of growing cotton more advantageous. There the land was plowed in the flat and not ridged, but plowing and planting were delayed in defiance of the canon to plant early because farmers felt it necessary to anticipate a weeding bottleneck by plowing only after the weeds had germinated following advent of the rains. Then, however, the desire to expedite sowing led farmers in most cases simply to broadcast their seed instead of planting them in rows as they were counselled to do by the Department of Agriculture. Here again, the methods of husbandry left much to be desired from a technical standpoint, but probably produced in most cases a larger return to labor than available alternatives.11

Conditions governing intensification

The above examples are not intended to suggest that in all of tropical Africa (and, indeed, even in any particular part) attempts to increase yields per unit of area are invariably doomed to futility. This would be far from true. However, they do illustrate the importance of examining carefully the variety of factors that are likely to determine the degree of success or failure of such efforts.

The amount of labor required

Much will obviously depend on the amount of extra labor (or other expenditures) required in relation to the demonstrable increase in yield. Spraying usually does not require much extra labor, so that it tends to be readily accepted if it clearly produces a significant rise in yields net of treatment costs. For example, over recent years the spraying of cocoa trees against capsid and black pod has made considerable progress in both Ghana and Nigeria and has apparently contributed significantly to productivity. On the other hand, the success of measures to stamp out the swollen shoot disease in cocoa has depended largely on enforcement because the adverse effect of this disease is not always so clearly evident and its eradication can

only be accomplished by the rather laborious process of cutting out all the affected trees. Similarly, the application of chemical fertilizer, which requires very little labor, will be readily adopted provided that the farmer is clearly convinced it will bring him a significant net cash profit every year; but the use of manure, which must be produced and applied in large quantities and requires a lot of labor, will tend to meet with much more resistance.

The time when the additional labor required for higher yields must be furnished is also of crucial importance. If the practice requires more labor when the farmer is already overburdened, it is likely to be rejected. Thus the counsel of early planting and early weeding is often rejected by farmers who find that by staggering these operations they can more fully utilize their own labor and achieve a higher aggregate output.

The difference in yields

Still another factor likely to affect the success of intensification is the level of yields which extensive cultivation can produce by comparison with more intensive methods under given ecological conditions, including the fertility status of the soil. We noted that, in dryland farming, efforts to raise cotton yields in Mali had apparently been more successful over recent years than in Sukumaland. Although considerably less than 10 percent of the cotton farmers were as yet following improved practices, including spraying and the use of manure and fertilizer, there has been in fact a more widespread and more rapidly growing response to intensification than in Sukumaland, and the benefits of such intensification also appear to be more striking. In a number of respects—sophistication of the farmers, rainfall, availability of land—the cotton-growing areas of Mali and Sukumaland are not markedly dissimilar. While it is by no means

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12 When enforcement of this practice was abandoned in Ghana in July 1962 there was a very sharp drop in the number of trees cut out until, two years later, the regulation was again enforced.
13 In an unpublished paper, *Seasonal Labour Inputs in Peasant Agriculture*, written following a survey of labor utilization on a number of farms in a rather dry area (Masii Division) of Machakos District in Kenya, Judith Heyer has observed: "While it may be best to plant in pure stands to get the maximum yields per acre, and while it may be best to plant early and to weed early and well, this may not be within the possibilities determined by the size of the labour force in relation to the land unit. Where there is any shortage of labour at peak periods, rather than do what the Agricultural Department advises and use precious labour at peak times, but waste off-peak labour, peasants adapt themselves to the shortage. They do plant some crops early and weed them early and well, but they also plant more crops a bit later, and weed them later and less well, knowing that they will get lower yields as a result."
easy to account for the variation in responses, we suspect that the difference in yields obtainable under ordinary cultivation, but with the use of improved varieties, is an important factor. In Mali this yield was probably not much more than 200 lbs. per acre owing to the shallowness and poverty of the soil as well as the damage done by various parasites; but in Sukumaland, where soils are generally deeper and more fertile, and parasitic attacks were usually less serious, yields were probably closer to a level of 400 lbs. In Mali it is likely that there is both greater pressure to improve yields and more opportunity to achieve good increases. Such a conclusion can, however, be advanced only as a hypothesis subject to verification.

**Differential population pressures**

We have been impressed by the need for differences of approach to the problem of intensification even within the same region. For instance, the pressure of population on land, which is a crucial determinant in the need to achieve higher yields, may vary widely. Thus in those parts of West Africa where the pattern of scattered village settlement obtains, land near the village tends to be scarcer than that farther in the bush. Such land is therefore generally cultivated more intensely, with the farmers using manure and household waste to prevent a deterioration in its fertility. Referring again to dry-land cotton cultivation in Mali, we suggest that the growing inclination to adopt more intensive cultivation is also due to the fact that cotton is grown close to the villages because it is a crop which requires more continuous care than most others. In Sukumaland, too, we found that there were considerable variations in the principal factors—ecology and population pressure—which condition receptivity to intensification. For the sake of simplicity there is often an excessive temptation to apply uniform approaches when differences in conditions make this inadvisable. In fact, we noted such a tendency in Sukumaland. Thus the very favorable responses obtained in a considerable number of fertilizer trials carried out on nearby Ukerewe Island had produced a program to expand the use of fertilizer rapidly on the mainland—i.e., in Sukumaland. However, higher population pressure, reduced soil fertility and better rainfall have created conditions on Ukerewe that are much more favorable to the use of fertilizer than those prevailing over the greater part of Sukumaland. There was reason to believe that in some portion of Sukumaland, where land was scarcer and rainfall more reliable, a fertilizer program might well be a success. In other areas, however, caution was indicated.
Changes in conditions

Finally, it must always be kept in mind that the factors conditioning the success of intensification are changing. We are not referring here primarily to the technological constraints which may indeed be altered in such a way as to improve the increased yield potential in relation to the cost and effort involved. Above all, demographic pressures are likely in the long run to become more manifest; and the tendency to want more income and higher standards of living may well bring about a growing disposition to work harder and even to accept diminishing marginal returns to labor when this is essential.

As a matter of fact, Africans have shown a capacity for responding to changing population pressures. In the past this has often taken the form of migrations by whole tribes or by kinship groups in search of land. More recently such adjustments have become progressively more difficult owing not only to the settlement of formerly unoccupied lands but also to the increasing permanence of habitations and the tendency of tribes to establish "spheres of influence" or "zones of occupation" in which outsiders are not accepted, or are only admitted subject to restrictions. Even modern nationalism has not been able to overcome this type of particularism. In many ways this is unfortunate because there are still wide disparities in population densities and land resources in Africa, and full use of good land is often prevented by the persistence of "tribalism." In Kenya the disparity in the availability and intensity of utilization of land between such tribes as the Kikuyu and the Masai has long been patent. In the same country it has been difficult to administer a program for the settlement of land bought from European farmers in such a way as to assist in relieving overcrowding in some agricultural areas; and the transfer of farmers under this program from lightly populated areas has in a few instances even caused production to fall in these areas. In Tanzania, however, the Sukuma have still found it possible, over recent decades, to move on a large scale into

14 William Allan has written (The African Husbandman, p. 284): "Wherever agricultural people increased in numbers beyond the capacity of the land to absorb them, groups and subtribes could hive off and move to fresh land in which to establish a new focus of settlement. . . ." He (and also Dumont, with respect to the former French areas of Africa) has noted, however, that the concepts of "order" and "administration" brought by European rule have been instrumental in fixing tribal boundaries and in promoting permanent settlement, thus progressively limiting the possibility of adjustments through spontaneous movements of population.

15 We noted a striking example of this in part of the Elgeyo Division of Elgeyo-Marakwet District in Kenya. See our case study, "The Experience in the Districts of Baringo and Elgeyo-Marakwet," in Vol. 2.
new and relatively unoccupied land. Yet by and large, labor migration has become the primary way in which people react to population pressure and the lack of readily available opportunities for agricultural development.

**Spontaneous and induced intensification**

In the past a more or less spontaneous adaptation of methods of cultivation to growing land scarcity has at times taken place. This has tended to occur on islands where opportunities for expansion into new areas were not available, or, more frequently, in rather inaccessible but fertile mountain or hill areas. For example, varying degrees of spontaneous intensification have been noted among the Kara on Ukara Island in Lake Victoria, the Chagga on the slopes of Mount Kilimanjaro in Tanzania, the Gishu on Mount Elgon and the Kiga in the montane regions of Kigezi District in Uganda, the Kofyar on the Jos Plateau in Nigeria, the Kabré of northeastern Togo and the people in the Mandara Mountains of Northern Cameroon. The degree and success of intensification in such areas have varied widely. Among the labor-intensive practices that have been adopted, though by no means everywhere, are terracing, the cutting and storage of fodder and the stall-feeding of cattle, the production and use of compost and manure, etc.\(^\text{6}\) It is interesting to note that when population pressure drops somewhat because new land or new employment opportunities open up, intensification also tends to diminish. This has happened, for instance, both where people have spread out on their own initiative (the Kofyar and Kara) or where they have been resettled on government initiative (the Kabré). On the new land thus occupied or settled a reverse adaptation to more extensive cultivation may then take place, as was the case when the Kabré were resettled in the Mono Valley.

In referring to these past cases of spontaneous adaptation to changes in circumstances, we do not intend to suggest that the current problems arising out of growing population pressure on land will be resolved without government intervention. Far from it. For every case where there has been some degree of successful adaptation, one can undoubtedly cite others where people have failed to

adapt and there has been considerable deterioration in the natural habitat. Moreover, spontaneous intensification has seldom proved very satisfactory unless it has been accompanied by the introduction, with government help, of a profitable cash crop such as arabica coffee among the Chagga and the Gishu. Usually the more intensive systems of farming that people have adopted on their own initiative have tended simply to stabilize incomes at a very low level in the face of mounting population pressure. In part, this may well be due to the tardiness of the adjustment in farming methods. Often the deterioration in environment is slow and not easily perceptible, and under these circumstances farmers tend to continue their extensive practices of cultivation and grazing. While we have earlier pointed out that African cultivators and herdsmen usually do recognize the signs of deterioration, the recognition may come too late or, in the great majority of the cases, those involved are unable to devise appropriate remedies themselves. Government can provide decisive assistance not only because it can hasten, through appropriate propaganda, a recognition and understanding of the situation, but also because it can command the knowledge and credit to devise the solutions.

The issue therefore is seldom whether government should intervene, but when and how it should undertake either to resettle people or to induce them to adopt new methods of farming that are more in accord with changed and changing conditions, particularly those resulting from demographic pressures. The importance of timely government action is well illustrated by the great improvement in agriculture that has taken place since the early '50's in the central part of Kenya inhabited by the Kikuyu. There, the growth of population together with continued adherence to customary methods of cropping and herding had produced serious fragmentation of land, soil erosion, loss of soil fertility, and a high rate of labor migration. It proved possible to reverse this trend at least temporarily by a combination of government measures including, particularly, land consolidation and registration and facilities for the introduction of cash crops and productive dairy cattle. In this case the remedial measures were appropriate, and people could be persuaded to accept them, no doubt partly because those who would have been most inclined to oppose the drastic intervention in land tenure were being detained under the emergency regulations enacted as the result of the Mau Mau rebellion.

Now that most African countries have become independent it may be easier in principle to awaken people to the need for intervention. In the past agricultural and range management officers
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who became justifiably alarmed about deterioration of arable and grazing land were often frustrated in getting acceptance of measures providing for soil conservation, grazing control or new methods of cultivation and land use simply because they and their proposals were unfavorably identified with colonialism. Today enlightened African political leaders have the challenging opportunity, through propaganda and education, to help people to realize in time the need for modifying their methods or patterns of production. Care must still be exercised, however, to avoid propagating particular changes or efforts to intensify production before they are really required or before their concrete merits have been effectively demonstrated. Their appeal is likely to be determined particularly by the extent to which account is taken of the labor constraints which many African farmers experience.

Resource utilization and maximization of returns

We now turn to a more specific discussion of these labor constraints. Their importance can hardly be overemphasized. It is a question primarily of seasonal bottlenecks. The fact that the total number of hours or days worked by farmers during the entire year may be small should not obscure the difficulty experienced in coping with their tasks at certain times. The seriousness of this difficulty may vary widely. Seasonal labor peaks tend to be particularly high in savanna areas where climatic factors, particularly rainfall, severely limit the cropping season and put a premium on the timeliness of agricultural operations. The fluctuation in labor requirements may be much less great where rainfall is more evenly distributed and both climate and soils are such as to permit greater flexibility in the timing of agricultural operations or a greater choice of crops and combinations of crops and livestock. Such conditions, however, are not found in many areas of tropical Africa. It should be kept in mind that the bottleneck may result not only from an absolute shortage of labor and the efficiency with which it is utilized, but also from the prevailing system of values which may make farmers unwilling to put in more labor even though an outside observer might conclude that available labor resources could be more fully utilized. In any event it is important to know what bottlenecks exist and how they might be eliminated. This is true no matter how one is seeking to increase output, whether by improving the timeliness of agricultural operations, by extending the area under cultivation, or by intensifying production through a variety of additional inputs per unit of area. Time and again the introduction of new crops and new practices has failed to achieve the results expected of them, simply because
they involved more labor at a time when farmers already considered themselves overburdened.

Identification of bottlenecks

It is therefore important in each case to identify the nature and seriousness of peak labor requirements. In areas where the growing season is short, owing to the pattern of rainfall, or where the hoe is the only implement, sowing and weeding together frequently constitute a single bottleneck since the weed problem tends to become acute before all the land is sown. Sometimes the preparation of the land, rather than sowing or weeding, is the bottleneck. In Sukumaland we noted that where ecological conditions dictated the cultivation of cotton and maize on ridges, it was the making or splitting of ridges which was the critical operation. However, where maize and cotton was sown in the flat elsewhere in Sukumaland, weeding was the bottleneck. In the Bouaké region of the Ivory Coast we found that the preparation of hills for yam cultivation created a crucial labor peak. Where there is considerable rainfall and a lot of bush, the clearing of land for cultivation may be the limiting factor, at least for the crop grown at the head of a rotation.17

Often there are two critical labor peaks. In the Gezira irrigation scheme in the Sudan, for example, such peaks occur in July–October when cotton, dura and lubia must be planted and irrigation channels and fields prepared to receive water; and again during January–April when cotton must be picked, the stalks subsequently pulled up and the fields cleared.18 The extent to which harvesting may be a bottleneck depends on the loss involved in protracting the harvest and its possible coincidence with other farm operations. Where the climate permits cropping during two seasons each year harvesting may coincide with land preparation for the next season.

In identifying labor bottlenecks, two factors must be taken into account. One is that studies of actual labor inputs on farms often do not reveal the full extent of the problem because they already reflect the spacing of work over a much longer time than optimum timing of operations should really permit. Thus, limited labor availability tends to smooth out the peaks. The other is that peak labor require-

17 For instance, this appears to be true of the cotton-growing area in Central Oubangui of the Republic of Central Africa, where annual rainfall averages about 1,500 mm. or 59 inches. See République Centrafricaine, Mission Socio Economique Centre Oubangui, L'emploi du temps du paysan dans une zone de l'Oubangui Central (Ministère de la Coopération, Paris, November 1961).
ments for men and women are in most cases different from each other, because men and women each tend to have their own land, their own crops and their own special tasks. For men, land clearing and land preparation may be the busiest time, but for women it is usually weeding of subsistence crops and help in tending cash crops. Considering the fact that women must do domestic as well as farm work, they usually experience higher labor peaks than men. In some areas the differentiation between men’s and women’s farm tasks is becoming less marked. In introducing various types of innovations, however, it would still be a mistake to assume that family labor can be treated as a single unit. In most cases one cannot expect family labor to be pooled and to be used with maximum efficiency until men and women share alike in all crops and in the income from all farm activities. This requires sociological changes that only African leaders among both men and women can bring about.

**Factors affecting labor availability**

Apart from the division of labor between men and women, there are other factors affecting labor availability that must be taken into account in assessing the practicability of changes in farming systems and methods. One of these is the incidence of sickness and disease. Unfortunately there is little reliable quantitative information on the importance of this factor, and that generally refers only to the loss of days due to sickness over the entire year rather than during any critical labor period. In our field work we were often struck by this testimony regarding the marked effect of poor diet and disease on labor input. Such debilitating diseases as malaria, bilharzia, Guinea worm, and various types of intestinal parasites may exact a serious toll. The advent of the rains not only heralds the beginning of the

19 A few examples may be cited. In two villages in the Oubangui area of the Republic of Central Africa it was found that men worked only 67 percent and 72 percent as long as women. (*L'emploi du temps du paysan dans une zone de l'Oubangui Central.*) In a Boualé village near Bouaké women tended to do 15 percent to 20 percent more work than men (unpublished study). On Nigerian cocoa farms women did about 17 percent more work than men (Galletti, Baldwin and Dina, *Nigerian Cocoa Farmers*, p. 294); and on three out of four settlements surveyed in Kenya in 1963/64 the women in the family did more farm work than men. (R. H. Clough, *Some Economic Aspects of Land Settlement in Kenya*, Egerton College, June 1965.) While some surveys have shown that men do more work than women, this in most cases is due to the fact that they ignore the nonagricultural tasks of women.

20 The labor survey in the Central African Republic to which we have already referred showed that over the entire year women were sick 4.6 percent of the time, and men, 1.9 percent of the time. In one of the Boualé village studies which we have also mentioned the number of days adults and adolescents were reported ill was 9.4 percent of the total.
busy period but also frequently brings a higher rate of illness consequent on the change of season. Improvements in public health may therefore at times markedly affect the capacity for work.

Rituals, ceremonies and social activities may also affect labor availability. Work on certain days or at certain times may be forbidden in deference to bush spirits. Deaths usually entail more or less lengthy interruptions of work; and rites and ceremonies on other occasions may also be time consuming. While the introduction of cash crops often brings about some degree of "secularization" of life and land which diminishes the importance attached to the observance of various religious requirements and rites, it does not necessarily diminish the value people attach to leisure and social activities. Even at peak labor periods these may continue to have some claim on the farm family's time.

Nonagricultural tasks must also be taken into account in assessing the availability of labor for work in the field. Women must often spend a considerable amount of time in the preparation of food, such as the pounding of grain, or go far afield in the search for fuel and water. The marketing of small quantities of foodstuffs usually takes an inordinate amount of time, although part of this must be considered "social activity" rather than "work."

Communal labor groups

The extent to which family labor can be supplemented by outside labor varies widely and may be a crucial determinant in the development of crops for the market. There are still many tribal societies in Africa where it is not customary for a member of one family to perform wage labor for a member of some other family, although, as the experience of the Kikuyu in Kenya suggests, such a custom may be rapidly discarded as the development of output for the market by some farmers creates a considerable demand for labor and inequalities in land distribution create a demand for wage employment on the part of others. Where wage labor is not yet available in significant quantities, communal work groups tend to be the only means of supplementing family labor. Such work groups, which may be formed on the basis of ties of kinship, age or neighborhoods, still play an important role in much of tropical Africa. They may be used for land clearing, weeding and other tasks. They may be organized on the basis of reciprocity, with the "beer party" at the conclusion of work as the immediate incentive; or they may consist of groups of individuals who work for cash or payment in kind and cash. In theory it would seem that such communal work groups do not increase the total supply of labor. In practice, however, people
working together are frequently willing to work longer than when they labor alone. Moreover, such heavy work as bush clearing, particularly when it also involves destumping, is considerably facilitated by group labor.²¹

**Labor migration**

It is migratory labor from other areas and other tribes that often provides the supplementary labor required to develop production for the market. The development of the large Gezira Scheme in the Sudan would hardly have been conceivable had it not been for its ability to attract labor for sowing and weeding and, especially, for the picking of cotton, from the poorer regions of Sudan and even from northeastern Nigeria, the Central African Republic and the Chad.²² In Buganda (Uganda) cotton and robusta coffee production were developed with the help of migrant labor from the comparatively poverty-stricken neighboring country of (then) Rwanda-Urundi. In West Africa, the expansion of cocoa and robusta coffee in the Ivory Coast and of cocoa in Nigeria²³ and Ghana owes much to the availability of labor migrants from the northern parts of these countries as well as from the Upper Volta and the southern part of Mali; and in Senegal, labor migrants play an important role in harvesting the large groundnuts crop.

It must not be assumed, however, that labor migration can automatically meet the labor requirements in developing agricultural areas. Much will depend on (a) the amount of labor required and the capacity to pay sufficiently attractive wages out of cash crop income, and (b) the extent and the distance of the actual or potential migrant labor reservoir. The continued expansion of the Gezira Scheme as well as the development of rainland cultivation farther south in the Sudan have apparently produced a growing competition for available labor which may eventually call for ad-

²¹ In a village of Gambia it was noted that the breakdown of the extended family, which used to pool labor for certain purposes, into nuclear family units has made it more difficult to clear land by axe and fire for millet production. This has made it necessary to rely more heavily on the rice crop which has traditionally been the sole responsibility of women. The reaction of the women “has been one of coercing the men to assist with rice production.” See M. R. Haswell, *The Changing Pattern of Economic Activity in a Gambia Village* (London, Her Majesty’s Stationery Office, 1963), p. 73.

²² In 1960/61, for example, tenant families supplied only 25 percent of the picking labor required on the main Gezira scheme and 18 percent on the Managil Extension. See D. J. Shaw, “Labour Problems in the Gezira Scheme,” *Agricultural Economics Bulletin for Africa*, No. 5, April 1964.

²³ A 1951/52 survey found that on the average 41 percent of the annual labor input on Nigerian cocoa/food farms was furnished by hired workers. See Galletti, Baldwin and Dina, *Nigerian Cocoa Farmers*, Appendix Table XXXVIII.
justments in patterns of production that would lessen peak labor requirements. In the cocoa and coffee regions of West Africa labor has evidently not been available on such a scale and on such terms as to make it economically attractive for most planters to intensify production by increasing labor inputs per unit of area.

On the other hand, there is often considerable scope for more efficient and fuller utilization of available labor. Surveys of labor employment on African farms by no means uniformly indicate that output rises with the use of more labor. They show considerable variation in the efficiency of labor. It is not, of course, surprising that there are marked differences in how hard people work and how effectively they organize their work. The management of hired labor is often particularly inefficient. Also, where wage labor is employed, the use of family labor frequently tends to drop. As we have already pointed out, the African farmer employing hired labor does so not simply to raise output, but also to "purchase" leisure for himself and, to a lesser extent, the other members of his family. Thus the "income elasticity" of demand for labor tends to be rather high, partly because the hiring of labor confers prestige and partly because leisure and the attendant ability to engage in "social activities" is still valued rather highly by comparison with the acquisition of material goods.

Labor migration often leaves certain areas in Africa to a large extent stripped of able-bodied manpower, making difficult any subsequent efforts to develop agriculture. The women and older men who are left behind often cannot cope with timely land preparation and bush clearance, and are generally disinclined to try anything new. A high degree of labor migration may, of course, be a correct reflection of the low agricultural potential at home and the comparatively more attractive opportunities afforded by wage labor in other areas. Under such conditions attempts to develop agriculture in the native regions of labor migrants are doomed to frustration. This we found to be true, for example, of the central part of Upper Volta where, with known production techniques, the prospects of development seemed very poor. The comparative attractiveness of labor migration has also been an important factor in the failure of development efforts in the drier areas of Machakos and Central Nyanza Districts in Kenya.

24 Shaw, "Labour Problems in the Gezira Scheme."
25 In some cases the farmer employing labor may also increasingly devote his own attention to other gainful pursuits, such as trade.
27 See our case studies on these two districts in Vol. 2.
On the other hand, labor migration may be high not because the potential for agricultural development is poor but because it is insufficiently appreciated or the conditions for capitalizing on it do not exist. Thus there was initially substantial labor migration from the fertile highlands inhabited by the Kikuyu in Kenya owing to the low technical level of traditional farming and the delay in introducing profitable types of agriculture for which natural conditions were quite favorable. Eventually it was possible to arrest and, to some extent, reverse the trend toward ever higher labor migration. Not only did the population become aware, with government assistance, of the opportunities for growing potatoes, arabica coffee, pyrethrum and tea and for practicing modern dairying, but, as we have seen, land consolidation and registration also helped to create conditions conducive to farm development. Similarly, the development of coffee production has made it possible to counter labor migration from the higher areas of Machakos District; and even in Central Nyanza we noted that newly realized opportunities for profitable cultivation of cotton and sugarcane were apparently beginning to have greater attraction for some people than external wage labor. However, where the habit of labor migration is deeply ingrained and does seriously deplete the supply of able-bodied labor, government efforts to stimulate the exploitation of an apparently neglected potential for development are likely to succeed only if they disclose rather striking income-earning opportunities or if they are continued, in the absence of dramatic opportunities, over a sufficiently long time to demonstrate to an ever-growing number of people that farming is, in fact, more remunerative than labor migration.

The need for farm management studies

If more effective use is to be made of limited resources—whether labor, as in most cases, or land, as in a smaller but increasing number of cases—much greater attention will have to be paid to the need for farm management or farm economic studies. These should be undertaken, above all, in areas where there appears to be a considerable potential for higher output but where, for reasons not quite clear, the recommended methods of achieving it are not being adopted.

28 See our case study on Nyeri District in Kenya in Vol. 2.
29 Other instances of a decline in labor migration following the introduction of cash crops have been reported. See, for example, E. Colson, Marriage and the Family Among the Plateau Tonga of Northern Rhodesia (Manchester, Manchester University Press, 1958, p. 66), and P. H. Gulliver, “Nyakusa Labour Migration,” Rhodes-Livingstone Journal, Vol. XXI, p. 56.
In the first instance, sample surveys will have to be made to determine what land and labor resources farmers have available, to what degree and how they are using such resources over the year and what gross and net output they enjoy. The amount of family and outside labor used during the busiest period or periods should give an indication of the limits of labor supply which innovations in methods or patterns of production will have to respect, at least initially. To be useful, the survey should cover nonagricultural as well as agricultural activities and distinguish between those of men and women. They should record data for the farm as a whole as well as for separate crops and livestock. Where there are wide differences in the size of farms, it is important to include an adequate sample of each major size category so that the problems and results of resource use on each can be adequately illuminated.

The information sought in such surveys has to be obtained primarily by interviewing farmers periodically and can only be supplemented or checked to some extent by direct observation. The required frequency of interviews and observations will vary with the complexity of the existing system of farming. Cross-checking will be necessary to improve accuracy, and any systematic bias can only be corrected as the result of experience. It will not be possible to get objectively accurate data in all respects. This need not always be a handicap. For instance, it is probably more important to determine when a farmer considers himself and his family overburdened with work than to verify whether the number of days or hours of work he reports is objectively correct. In any event, enough surveys of this type have already been done to demonstrate that the problems in getting the right sort of information are not insuperable.

Experience with surveys that have already been made shows that the use of resources and the resulting output is likely to vary widely within the sample. In such cases attention must be paid both to the frequency distribution within the sample and to the reasons for the differences in performance among the farmers. A careful analysis of the factors that have enabled certain farmers to achieve superior results is particularly important because it may well suggest ways and means of improving the resource utilization of the other farmers. If the superior results are attributable to the availability of more family labor or of more or better land, they have no relevance to other farmers. On the other hand, if the higher output is due to the fact that the farmer works harder and more effectively, has better implements, uses improved methods of crop or animal husbandry, grows different crops or employs different crop rotations, then the possibility that the less efficient farmer can be induced to profit from
this example is given. As a matter of fact, an agricultural extension service can often be most effective if it can single out the better farmers and get others to follow the practices they have found worthwhile and practicable. In such cases one must make sure, however, that these farmers are not considered by others as so atypical that their example will not or cannot be followed. In any society, for instance, probably only a minority of people will work extremely hard, just as only a small number may be extremely lazy. In the practical work of promoting agricultural development it should therefore be recognized that the greater number of people will probably fall between these extremes and that efforts to improve their output will have to proceed, at least initially, within the limits set by their existing capacity for work.

Once it is known at what rate and with what results farm resources are actually being employed throughout the agricultural season, it becomes possible to consider how new methods and new crops or combinations of crops can best be introduced. The implications of these innovations for labor requirements and the probable net return to both land and labor must, of course, be established, preferably as the results of trials and experience under actual farming conditions. One can then explore how new methods or new patterns of production can best be fitted into or used to alter the existing farming system in such a way as to maximize returns to land or labor, whichever is the scarce factor.

The analysis of alternatives

Various agricultural economists have illustrated the possibilities of working out better farming systems within certain limits of labor availability. One, for example, used linear programming to determine the appropriate proportions of land that should be devoted to three crops—groundnuts, maize and millet—taking into account that in any ten-day period the farmer was unlikely to have more than 100 hours of work and that the incidence and amount of labor required are somewhat different for each of the three crops. In this way he was able to demonstrate that a shift in the crop proportion in favor of groundnuts and millet, as compared with that obtaining on an “average” holding, could raise the total of labor utilized throughout the season from 1,252 hours to 1,418 hours and increase the value of the total output from Sh 523 to Sh 600.30 This particular

30 See R. W. M. Johnson, *The Labour Economy of the Reserves* (Occasional Paper No. 4, Department of Economics, Salisbury, University College of Rhodesia and Nyasaland, 1964), Chapter IV.
example assumed that labor peaks are inflexible. It may, of course, be possible within certain limits to lower peak labor requirements by staggering planting and harvesting and, providing the effects on yields are known approximately, to work out the optimum use of labor taking this into account. The economics of the use of implements and machinery to widen labor bottlenecks can also be analyzed in this way. Similarly the comparative merits of various improved methods of production that require additional labor at certain times can be worked out. For example, different combinations of manure and fertilizer dressings may, through their impact on seasonal labor patterns and yields, alter the cropping pattern that would otherwise be best. In still another case, the comparative value of eight different improved farming systems, varying the use of implements, hired labor, and such inputs as fertilizers and insecticides, has been illustrated.

The above examples all assume that availability of labor is the fundamental constraint. The same technique of analysis can, of course, be applied if land is the limiting factor. Other constraints can also be introduced. It may be necessary to recognize, for example, that a certain minimum amount of labor and land must be allocated to particular crops that will meet the subsistence and dietetic requirements of the farm family, and that only the use of land and labor in excess of these needs can be varied.

To be effective, this type of farm economic or farm management analysis must, of course, be able to proceed from realistic premises. It cannot postulate an "average" farmer who does not in fact exist. Any sample survey must seek to classify farmers in groups which differ from each other significantly with respect to such factors as resource endowment, experience and work capability. Possible ways of improving output will need to be worked out for each of the more important groups in the light of whatever limitation or limitations in production may have been shown to be critical. Moreover, the results of the analysis must be regarded as being only indicative of possibilities for improvements which must subsequently be tested in pilot agricultural extension programs.

Care must also be exercised to avoid making this type of analysis too complicated. In theory one can certainly make the number of combinations of resources so great as to make the whole task impracticable. In practice, however, it will generally suffice to consider

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31 Ibid., Chapter V.
32 This was done by an agricultural economist attached to Ukiriguru Research Station in Sukumaland. See M. P. Collinson, Farm Management Survey No. 3 (mimeographed, Western Research Centre, 1964).
only a few alternatives. Some will in any event be ruled out by ecological and market considerations. Others may require too much sophistication in the circumstances. Moreover, the aim need not be to achieve an optimum use of available resources, but rather to obtain a somewhat better use than the one that is current. The complexity of the analysis involved will vary with conditions. In many cases the issue may be rather simple and, therefore, easy to resolve, always providing that the pertinent basic facts are first ascertained. In examining the problems of one of the rice-growing areas of the Office du Niger in Mali we suggested, for example, that the basic alternative was not necessarily whether to grow rice by transplanting or by direct sowing, but rather what combination of transplanting and direct sowing would make the best use of available labor resources. The data essential for exploring this were not at hand, but could presumably be quite easily obtained. Similarly, we noted in the Bouaké region of the Ivory Coast that considerable success was being achieved in fitting a new and profitable crop—cotton—into a traditional farming system centered on the cultivation of yams. The achievement of this “fit” was not through complex analysis, but by the simple recognition that the production of yams was characterized by a certain labor bottleneck and that, accordingly, it was necessary to devise a method of cotton growing which utilized labor when it was not needed for yam production.

The requirement for more economists

Admittedly, extension workers who deal directly with the farmers cannot be expected by themselves to devise better, let alone optimum, methods of utilizing the resources actually or potentially available to farmers. This task for the most part can only be done by agricultural economists working in close collaboration with professional men on research stations, on the one hand, and the extension service, on the other. Research personnel must provide information on the technical production possibilities, and the extension staff, working under the close guidance of the economists, must provide, through sample surveys, data on existing farming systems and the limiting factors within which these operate.

Unfortunately, the number of agricultural economists working on problems of farm management in tropical Africa has been pitifully small. Their usefulness has been inadequately appreciated in the

34 See our study, “Ivory Coast: The Program of Animation Rurale in the Bouaké Region,” in Vol. 2.
past. It has been estimated, for example, that the cumulative total of agricultural economists employed by the United Kingdom Colonial Agricultural Service by 1955 was no more than about one dozen.\textsuperscript{35}

An inadequate number are being trained, and their training is often too much focused on macro-economics as distinct from the micro-economic problems encountered at the level of the individual farm enterprise. In a few African countries the value of agricultural economists has received some recognition over recent years, and useful pioneering work has been done by such economists, particularly in Kenya, Tanzania and Southern Rhodesia. Yet the number is nowhere sufficient, and in many countries there are no agricultural economists in the government service. In our field work we have encountered many problems which can only be resolved with their help. A major effort should be made to train and employ more agricultural economists, for these could be of immense value in raising output by helping to diagnose the problems confronting farmers and to devise more economic ways of using available resources.

CHAPTER SIX

IMPLEMENTS AND MACHINERY

Introduction

In view of the seasonal labor bottlenecks and lack of equipment that characterize most of tropical African agriculture, the introduction and use of appropriate implements, whether animal-drawn or tractor-drawn, is of great importance. Unfortunately, the problems involved in finding or devising the right kinds of equipment and type of traction and of overcoming the obstacles to their effective employment are as yet far from resolved. Animal-drawn implements have been readily adopted in certain areas but have proved unsuitable in many others; and the integration of animal and crop husbandry, of which animal traction was to be only one feature, has seldom been accomplished. The limitations of animal-drawn implements, the impatience with the problems posed by their use and the widespread desire to embrace immediately the technology of the twentieth century produced numerous schemes for mechanizing agriculture, particularly after World War II. The first of these were launched by colonial governments, often for the purpose of overcoming shortages of foodstuffs or raw materials which were expected immediately after the War, but many new ventures have been launched by African governments in the post-independence period. All these experiences have demonstrated not only the difficulty of the many problems involved but also the need for perseverance in coping with them, keeping in mind the lessons of the past.

Before discussing these problems, a few preliminary observations must be made. The first is to make clear that the word "mechanization" will be used in the narrow and more popular sense as referring only to motorized or tractor-drawn equipment, rather than to all machinery, including that employing animal draft. The second is to disclaim any intention of being exhaustive or comprehensive. The problems involved in the selection and operation of implements and machinery are too complex and the experiences with them too many
to permit their detailed consideration within the scope of a single chapter. We shall concentrate on some of the principal issues and difficulties encountered in equipping African agriculture in the hope that this may help put the problems in better perspective and to avoid some of the pitfalls of the past. Except where specifically noted, we shall be primarily concerned with implements of cultivation, largely because these play a particularly significant role in widening bottlenecks and often pose the most difficult problems, including the need for rather far-reaching transformation of agriculture. This is not to deny the importance of many other tools and types of equipment, including improved hoes, sprayers, dusters, sickles, oxcarts, etc. We have had the occasion to emphasize the importance of these in many of the case studies. For instance, the cart, whether drawn by oxen or donkeys, can be of great help in transporting harvested crops, litter, manure, fuel and water, thus releasing labor at critical times for other tasks and facilitating such improvements as the production and use of manure. Hand grinders for maize and other equipment for the preparation of food can be instrumental in relieving the frequently excessive work load on women. In East Africa we noted that the failure to devise efficient but cheap equipment for decorticating sisal on the farms was an obstacle to the development of the drier areas. Such examples could be multiplied.

In the ensuing discussion we shall attempt above all to define some of the more critical limitations within which animal-drawn and tractor-powered equipment must be applied. In view of the emphasis which the preceding chapter put on labor as a critical factor of production, we hope that the approach in this chapter will not expose us to the accusation of being negative. It is better to note the difficulties illustrated by past experience, than to encourage the notion that the improved equipment of African agriculture will be an easy task.

Finally, it should be noted briefly that animal or tractor cultivation is not necessarily relevant to the development of all areas in tropical Africa. Hand cultivation, for example, will continue to be necessary or economic where:

1. topography makes plowing too difficult or undesirable;
2. demographic pressures make holdings too small for cultivation with tractors or for supporting draft animals;
3. the forest cover is so dense as to preclude economic clearing except for hand cultivation;
4. tree crops can be grown such as arabica coffee and tea in East Africa and robusta coffee and cocoa in West Africa, or eco-
logical conditions make it possible in other ways to obtain a satisfactory output with hand tillage alone; and
5. enough labor can be hired at reasonable cost to cope with peak labor requirements.

Under the last two conditions profitable farming can, in fact, be developed. This has been true, for example, of much of the forest zone of West Africa and of the hilly, densely populated highlands inhabited by the Kikuyu in Kenya. The latter area not only has access to a considerable reservoir of wage labor, but has had the possibility of combining dairying, tree crops and seasonal cropping in such a way as to create better opportunities for the fuller utilization of labor throughout the year.

In this chapter we shall first deal with some of the problems common to both animal-drawn and tractor-drawn implements and then continue with a separate discussion of each.

Some general considerations

Labor bottlenecks and output

In general the use of animal-drawn or tractor-powered equipment is justified only if it succeeds in breaking labor bottlenecks or significantly improves the quality of certain agricultural operations. The elimination of labor bottlenecks should permit the more effective and fuller utilization of labor resources over the entire agricultural season rather than a saving in the total amount of labor used. The cost of operating and depreciating machinery, particularly in the case of mechanized equipment, may alone necessitate a considerable increase in output; and the total rise in production that is required can usually be achieved only by working in the aggregate more rather than less. Yet in much of Africa there is a constant temptation to couple the use of implements and machinery with a reduction in labor input because farmers often fail to appreciate the cost of using machinery and tend to grasp at any opportunity to achieve their output targets with less labor.¹

¹ An example of this may be cited in the form of the following comment on the impact of a contract tractor plowing service in Bunyoro, Uganda: "In Bunyoro the service was largely one of saving the sweat of the farmer. There is almost no evidence of any increase in productivity. The cooperative movement in Bunyoro offers concessions to members without apparently stimulating any increase in production per acre or per person. At the end of three years the average acreage per cooperative member was the same as at the start. Just about an acre per man. It seemed that the Banyoro were not using mechanization to increase their agricultural potential, but rather, in all probability, to allow of more leisure. In itself this is not a bad objective, but it is perhaps not a high priority for a developing country." See J. L. Joy, ed., Symposium on Mechanical Cultivation in Uganda (Kampala, Uganda, Argus Ltd., 1960), p. 7.
Equipment can be used both to extend the area under cultivation and to improve the timeliness of such operations as sowing and weeding. These two objectives may not always be fully reconcilable. The use of equipment will generally prove too costly unless it can be extended over a considerable number of hours per year. The plowing season may accordingly be too prolonged, so that a portion of the area may be plowed too late. This may occur particularly where the fields or holdings to be plowed are widely scattered. There are also a number of practical limitations on the extent to which implements can help individual farmers to extend their cultivated area usefully. True, animal-drawn implements, as compared with the hand hoe, may be capable of preparing three or four times as much land, and tractor-drawn implements may in turn prepare, say, ten to twenty times as much land as an ox-drawn plow. Yet these ratios greatly exaggerate the possibility of expanded cultivation by the individual farmer. In the case of the tractor the size of the holding may impose a restriction, but even then a more important limitation on the expansion of the cultivated area may be the danger of creating other bottlenecks in farming operations.

The danger of creating new bottlenecks

In fact, the impact of removing one bottleneck, such as land preparation, on other actual or potential bottlenecks has often been inadequately appreciated in introducing animal or mechanical traction. Thus a weeding bottleneck can easily develop if implements are used primarily to prepare more land rather than to facilitate early planting or to release labor which can be devoted to weeding. In the mechanized Niger Agricultural Project which was started in Northern Nigeria after World War II, it was originally expected that mechanical land preparation would make it possible for each farmer to crop 24 acres. This proved to be wholly impracticable, however, because, without the mechanization of weeding, farmers simply could not cope with the manual task of weeding which required no less than 408 man-days of work over the six-week period.\(^2\)

At Nachingwea in Tanzania mechanical land preparation has enabled farmers to plant four or five times the area that they would

\(^2\) This is given only as a typical comparison. In exceptional cases, as in the rainlands of Sudan, where land preparation can be done with a wide level disc tiller and land is farmed in units of around 1,000 acres, one tractor may be able to deal with as many as 1,000 acres, or forty to fifty times the area that could be plowed with oxen.

otherwise have done, but since little mechanical help is available in subsequent operations the farmers apparently feel that they have trouble in taking care of such a large area. In the Gedaref area of the Sudan where “merchant farmers” have been growing sorghum on land plowed by tractors, one of the principal problems has been progressive weed infestation.

Under certain circumstances the employment of tractor- or animal-drawn implements for land preparation may actually contribute to weed growth. To make adequate use of the tractor, for example, plowing must often be started well in advance of planting dates, thus encouraging the germination and growth of weeds ahead of planted crops. This was found to be the case when tractors were employed for dry season or early land preparation both at Nachingwea on Tanzania and on the Niger Agricultural Project in Nigeria. Farmers using animal-drawn implements are also often advised to do some preliminary land preparation, wherever possible, before the advent of the rains or to carry out various types of land preparation that produce a more thorough working of the soil and facilitate the penetration of the early rains. Yet this advice is often ignored, at least partly owing to a fear that such practices tend to give weeds a head start. In the region around Ouagadougou in Upper Volta, for example, we noted that a French organization engaged in extension work was counselling farmers to use a cultivator drawn by a donkey to work the soil at least to some extent before sowing. This was to conserve water from the early rains in anticipation of subsequent droughts which often occurred and inflicted considerable losses on newly planted crops. However, the farmers were not accustomed to working the land before sowing. Toward the end of the dry season they remove crop residues left from the preceding harvest and “clean” the land by burning it over. Then, when the rains come they start sowing as quickly as possible and as much as possible, loosening the light soil a little as they plant with their hoes. Quite a few farmers evidently were convinced that if they first ran a cultivator twice across their land (one perpendicular to the other) this facilitated an

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4 R. F. Lord, *Economic Aspects of Mechanised Farming at Nachingwea in Tanganyika* (London, Her Majesty's Stationery Office, 1963), p. 99. The author also notes (p. 90) that mechanical land preparation may even add to the strains within the farm family because mechanization of this operation relieves men of work but may add to the burden of the women whose traditional task is weeding.

5 The fact that land has been plentiful has helped in dealing with this problem up to the present because land that had become too badly infested with weeds could be abandoned in favor of new land.

earlier and more prolific growth of weeds to the detriment of their planted crop.\footnote{See our case study, "Upper Volta: The Agricultural Extension Program of Société d'aide technique et de coopération in the Mossi Country," in Vol. 2.}

The interrow cultivator and the weeding problem

In principle, of course, it should also be possible to use animal- or tractor-drawn implements for weeding. In practice, however, this has proved difficult. Weeds tend to spring up immediately following the rains and to overwhelm the crop. While periodic bush fallow kills many weeds, the bare fallow that replaces it when land is cleared for the use of plows often leads to progressively greater weed infestation. Under these conditions interrow cultivation with the help of tractors or animals can be done without serious damage to young crops only if great care is exercised and the people and animals involved are well trained. At the later stages of crop growth interrow cultivation by tractor may also be made difficult by inadequate toolbar clearance.

The problem of interrow cultivation is illustrated by the experience during recent years in the central region of Upper Volta. The extension organization already mentioned had indeed introduced the cultivator there for the primary purpose of dealing with the weeding bottleneck. Since this implement could only be used if crops were planted on straight rows in place of the customary method of "step-plant-step," the animal-drawn cultivators were provided with row markers which could be used at the time of planting. However, the farmers' initial experience with interrow cultivation was often discouraging. The cultivator tended to uproot or bury young seedlings because the farmers did not adequately guide the implement and the draft animal was poorly trained. Some farmers persevered with the use of the cultivator and acquired the knack of using it, finding it possible in this way to extend the area under cultivation. But the great majority of farmers evidently had much less confidence in the cultivator than in the hand hoe as an effective weeding implement. This lack of confidence obviously made them equally reluctant to add to the burden of weeding by adopting land preparation practices that delayed sowing.\footnote{Ibid.}

Elsewhere too, such as in Mali, Chad, Kenya, and Tanzania, we found that the interrow cultivator had gained little acceptance. In fact, in Mali we noted that where draft animals were used for interrow cultivation, the plow was often preferred, particularly where it could be employed simultaneously for ridging of cotton; and in
Northern Nigeria farmers are also reported to use an ox-drawn ridging plow for weeding of furrows and remolding ridges. In the Gezira the remolding of ridges done by a tractor-drawn ridging implement during the early stage of cotton growing has evidently helped to reduce the weeding burden. These experiences, however, do not necessarily indicate that the interrow cultivator cannot in the end be effectively used in many areas to cope with the weeding bottleneck, provided that enough and persistent effort is devoted to training and there is further experimentation with cultivators of new and different designs.

Experience has shown that certain methods of land preparation with draft animals or tractors may help to reduce the subsequent weeding burden. We have already referred to the fact that farmers in certain parts of Sukumaland have found it useful to delay ox plowing, and therefore sowing, until the first crop of weeds has germinated. Similarly, we have mentioned that elsewhere in Sukumaland the cultivation of cotton and maize on five-foot ridges has the advantage of reducing weeding, due to the fact that the weeds are rather effectively buried when the ridges are split and remade. Such ridges are, however, made and split by hand; and tests conducted by the Ukiriguru Research Station have only recently indicated the possibility of making such a ridge economically, in a single operation, using a specially adapted, large moldboard ridger mounted on a tractor. Ox-drawn implements have not been capable of making five-foot ridges, but tests at the same station have demonstrated the capacity of an ox-ridger to make three-foot ridges which also provide quite good control of weeds and which can be planted in such a way as to permit subsequent use of a cultivator. In the Gezira, ridges are split mechanically before cotton planting, thus burying the early weed growth as well as the fertilizer that has been applied to the land. Finally, under some conditions several mechanical discings spaced over a certain period following the first appearance of weeds may be able to reduce the labor expenditure on weeding enough to be economic, at least for crops whose outturn

10 See R. D. Bowers, "Mono-Cultivation Based on Five-Foot Ridges," World Crops, March 1965. The tests showed that this ridger worked well on scouring soils such as the hill sands near the research station, but that nonscouring soils did not flow smoothly off the moldboard to form a properly rounded ridger profile. It was also reported that the ridger could be lifted hydraulically at 20-to 30-yard intervals in such a way as to form quite good tie ridges which have been proved useful in raising yields but which farmers have been reluctant to make by hand, owing to the labor involved.
11 See our case study on Sukumaland in Tanzania in Vol. 2.
is not seriously affected by the delay in planting entailed by this practice.\textsuperscript{12}

\textit{Possibility of a harvesting bottleneck}

The expansion of the cultivated area through plowing may also be limited by other bottlenecks such as harvesting. The extent to which such a constraint will obtain depends on the amount of labor required for harvesting, on the possibility of stretching out the harvest period without undue losses and on the practicability and economics of using animal-drawn implements or machinery also for harvesting. In any event experience indicates that the possibility of a harvesting bottleneck must be considered and taken into account.\textsuperscript{13} Cotton and groundnuts are examples of crops which do require considerable labor to harvest. In the case of cotton, picking cannot yet be effectively mechanized under African conditions, nor can the picking season be greatly extended without significantly affecting the quality of cotton. Thus when cotton cultivation is mechanized, the area that each farm family can handle must be carefully considered in the light of the family and hired labor likely to be available as well as the amount of cotton each person can be expected to pick, taking into account the anticipated yield per acre. The period for harvesting of groundnuts cannot be significantly lengthened at either end because of the danger of harvesting immature nuts at the beginning, and of losses due to the excessively hard ground at the end of the period. Here, however, there is the possibility of using either an ox-drawn\textsuperscript{14} or a tractor-drawn implement to lift groundnuts. At Nachingwea it was demonstrated that the use of machinery for digging groundnuts and combining soya beans made it possible for the tenants to grow more of these comparatively profitable crops

\textsuperscript{12} This was suggested by trials conducted by T. W. Clouston in the early days of mechanized sorghum farming on the rainlands of the Sudan. The “lessons” of these trials were, however, never reflected in actual farm operations, probably because they proved to be operationally impracticable. See Baldwin, \textit{The Niger Agricultural Project}, drawing on T. W. Clouston, \textit{Mechanization in Agriculture in the Rainlands of the Anglo-Egyptian Sudan, 1943–1948}.

\textsuperscript{13} In Uganda the following observation was made in 1960. “Labour is the greatest single problem at present hindering the growth of large-scale mechanical cultivation. The problem arises because of the unreliability of its supply and its rising cost and scarcity. . . . Even given a relatively high efficiency of labour it would seem that the overall availability of labour at harvest places a limit to the expansion of cultivation at the moment.” See Joy, ed., \textit{Symposium on Mechanical Cultivation in Uganda}, p. 21.

\textsuperscript{14} A. R. Stokes, “Mechanization and the Peasant Farmer,” \textit{World Crops}, December 1963. It should be noted that the period during which the ground is soft enough to permit the use of an ox-drawn implement is likely to be much shorter than in the case of a tractor-drawn digger.
which otherwise were restricted by the amount of labor required for harvesting.\textsuperscript{15}

\textit{Machinery and the intensification of production}

The introduction of machinery for cultivation generally makes it necessary sooner or later to intensify production, that is, to raise yields per unit of area through such inputs as fertilizer, manure, pesticides, improved varieties and the like. There are a number of reasons for this. In the case of mechanization particularly, the rather high capital and operating costs per unit of area may well increase the incentive to explore all available means to raise yields to a level which will cover total outlays and still leave a profit. A more important factor, however, is that the use of cultivation machinery greatly affects the scope and role of fallow in restoring and maintaining soil fertility. By facilitating the expansion of the cultivated area, it reduces the proportion of fallowed land. It involves the replacement of bush fallow with more or less continuous cultivation. For the most part this is due to the need for complete clearing of land, involving the removal of stumps, roots, rocks and stones which can interfere with plowing. In tropical Africa there are, to be sure, regions of relatively open savannah or steppe (e.g., the marginal rainlands of the Sudan and Sukumaland) which lend themselves to plowing with little or no clearing. In most cases, however, substantial clearing is necessary. Such clearing must be especially thorough if mechanization is undertaken. Costly breakages of the rather expensive tractor-drawn implements will occur if land is imperfectly cleared. On the other hand, oxen can more easily plow around the stumps or other obstacles or will more readily stop when the implement runs into a concealed root or stone. However, if the ox plow is to be supplemented by the cultivator, it becomes more important to remove roots and stones that may break the tines or may deflect the cultivator with resulting damage to the crop. The costliness of clearing thus provides an incentive for more continuous cultivation. While it is possible, of course, to fallow cleared land, this type of “bare” fallow is less effective than bush fallow in restoring soil fertility and, as we have seen, often aggravates weed infestation unless noxious weed growth can be economically controlled by regularly discing fallow land.\textsuperscript{16}


\textsuperscript{16} It should be noted that discing of fallow land can also be conducive to erosion.
It is not suggested that intensification of farming must always accompany the use of machinery. Under special conditions where clearing costs are low, inherent soil fertility high and the costs of working land with machinery are modest, extensive farming can be practiced. This has been true, for example, of the rainlands in the Sudan where land preparation can be mechanized at low cost and the land is such that it can apparently be cropped for as long as eight years without serious loss of fertility. There are also areas, as in Sukumaland, where ox plowing and extensive cultivation have proved reconcilable even though, in the long run, a growing shortage of land in relation to population may necessitate intensification.

**Plowing and soil erosion**

There is always the danger that plowing may greatly contribute to soil erosion. While hand cultivation can lead to serious erosion, particularly on hillsides, the smallness of the cultivated fields, the practice of interplanting and the remaining stumps and roots often provide some built-in safeguards. When large contiguous areas are plowed by tractor the erosive effect of runoff even on mild slopes is greatly increased; and even ox plowing of much smaller areas may accentuate erosion if, as frequently happens, plowing is not done on the contour. This is all the more true because tropical African rains often take the form of downpours. Yet the deeper and more thorough soil preparation that is possible, particularly with tractor-drawn implements, can also help to contain runoff by increasing the capacity of the soil to absorb and retain water. With proper safeguards such as plowing on the contour and the use of cutoff drains and grass strips, mechanized cultivation can have a favorable effect on yields through soil conservation and improved moisture retention. In the past, however, such safeguards often have been neglected. In the Niger (Mokwa) Agricultural Project, for example, the land was simply tilled in large rectangles and without respect to contours; and it was only much later that conservation practices with contouring and grass strips were introduced.¹⁷

The methods of conservation must be adapted to local conditions. On a small-scale mechanization project in the Central African Republic, for example, land is cultivated along the contours in long (280 to 840 meters) narrow bands the width of which has been fixed at 25 to 35 meters in accordance with a formula taking into account both the slope and the rainfall. These bands are separated either by

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a fallow strip of equal width or by a permanent anti-erosion stop which is 3 to 5 meters in width and reinforced by a ridge made with the plow and covered with grass.\textsuperscript{18}

The choice of implements

Experience has shown that the proper choice of implements and equipment is very important and often requires a certain period of trial. Disc-type plows have in many cases been found more suitable than moldboard plows, particularly where soils are shallow and conservation of moisture is a prime problem or where soils are particularly hard. By "riding over" roots or other obstacles a disc plow is also less susceptible to breakage. In the Sudan the possibility of carrying out effective land preparation with a wide level (16 ft.) disc tiller which works the soil to a depth of 2-2.5 inches at the rate of 5 acres per hour has been a very important factor in making mechanized cultivation of sorghum economic.

It is often desirable to test under actual farming conditions a range of equipment, not only to determine the suitability of various implements for a particular purpose, but also to take into account the possibility that the use of machinery for one operation may result in a bottleneck requiring the use of machinery for still another operation. In the Bokoro region of the Chad we noted the experience with a wide variety of equipment that had been introduced by the BDPA in its extension work. Various types of cultivators, a seed drill and a hand-operated groundnuts sheller were demonstrated to, and then tested by, groups of farmers organized into cooperatives. Most of the cultivators were found to be too heavy for the animal traction available. Interestingly enough, the implements that could help farmers with their groundnuts production had the greatest appeal. It developed that farmers experienced difficulty in preparing and sowing their land to this crop because they simultaneously had to weed their millet. They tended to use the cultivator primarily for preparing the land for groundnuts, and then the seed drill for denser and speedier sowing of this crop. Similarly, the groundnuts sheller proved popular because it enabled farmers to obtain better prices by marketing their crop earlier and before roads again became impassable.\textsuperscript{19}

We encountered many instances of the use of ill-suited equipment.


\textsuperscript{19} See our case study "Republic of Chad: The Work of the Bureau pour le développement de la production agricole in the Bokoro Area" in Vol. 2.
In the Machakos District and some other parts of Kenya we found farmers employing moldboard ox plows which seemed too heavy and not very well adapted to the drier areas. Similarly, the ox carts often appeared unsuitable or poorly constructed; and in the District of Central Nyanza we found farmers struggling with a bellows type of duster which was largely ineffective in treating cotton. In Mali, too, we noted cases where unsuitable equipment had been procured, usually because restrictions on foreign exchange availability dictated buying in certain countries. In fact in a number of countries the availability of suppliers' credits has at times governed the types of equipment and machinery procured without much reference to the specifications that really should have been met. Above all, the equipment and tools devised for conditions in other continents are often not well suited, even after some adaptations to the requirements in tropical Africa. Later in this chapter we shall revert to this problem.

Animal traction

We must now turn to a consideration of some of the potentialities and problems of animal-drawn implements. Normally oxen are the draft animals employed. True, donkeys can be, and are often, used to draw two-wheeled carts. In the central region of Upper Volta and the Bokoro region of the Chad we also noted that efforts to introduce animal-drawn implements focused, at least in the initial phase, on the employment of donkeys. The latter admittedly have some advantages in that they are less demanding in terms of feed and are somewhat more easily trained. However, their tractive power is so small that they can hardly be expected to pull more than a light cultivator; and they are susceptible to trypanosomiasis. Moreover, since the number of donkeys is usually not large and their ownership is not very widespread, the procurement of an adequate supply of these animals at reasonable prices may be a problem as and when their use becomes popular.

Advantages

Animal traction has a number of advantages which should not be lightly disregarded. Particularly important is its low cost in terms of

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20 See the case studies, “The Experience in Machakos District” and “The Experience in Central Nyanza District,” in Vol. 2.

21 For example, the price of a donkey in the central region of the Upper Volta rose from a level of between 1,000 and 1,500 CFA francs in 1961 to 3,500 francs in 1964 even though the effort to encourage the use of this animal for cultivation had been marked by only limited success. See our case study, “Upper Volta: The Agricultural Extension Program of Société d’aide technique et de coopération in the Mossi Country.”
foreign exchange. The draft animals are available or can be procured locally. Normally the animal-drawn equipment—plow, cultivator and cart—are still bought abroad, but their domestic manufacture, and certainly the production of replacement parts, can be much more easily undertaken than in the case of tractors and the implements used with them. In distinction to the latter, animal-drawn implements require virtually no recurring foreign exchange outlays.

Another advantage is that the costs involved in animal traction are not so large that an individual farmer cannot cope with them provided the implements permit him to grow a cash crop and he can get some credit for the purchase of the more expensive items. An ox plow may cost the equivalent of between $15 and $30 (3,750 to 7,500 CFA francs or Sh 107 to 214); and a cultivator $30 to $36 (7,500 to 9,000 CFA francs or Sh 214 to 257). The most expensive item of equipment is usually the ox cart, costing the equivalent of $100 to $110\(^{22}\) (25,000 to 27,500 CFA francs or Sh 715 to 785). The draft animals themselves may also be costly to acquire. Generally a pair of oxen suffices, although sometimes two pairs, and, still less frequently even three pairs of oxen are needed, depending on the oxen and the tractive power required to work different types of soil. A pair of oxen may cost the equivalent of $70 to $120 (17,500 to 30,000 CFA francs, or Sh 500 to 850). However, in many parts of Africa where ox cultivation is practiced farmers tend to keep cattle, quite irrespective of their usefulness as draft animals; and even where oxen must be bought they can often be sold after six or seven years without significant loss. However, there can be a "cost" in terms of the possible loss of oxen due to deaths or of the milk and progeny from cows which might be kept in place of oxen.

It is useful to consider the annual cost of draft animals and equipment, taking as a basis the medium of the price ranges given in the preceding paragraph. For draft animals this is particularly difficult, but if they have to be bought, an annual allowance of about a sixth of their capital value may suffice to cover the cost of acquisition and the risk of loss. As for the equipment, it should be sufficient to depreciate the cost of the plow and cultivator over six years and of the cart over ten years. If three oxen were kept (an extra one for the contingency of illness), the annual cost for animals and equipment would then be in the neighborhood of $50, including an allowance equal to about 5 percent of the capital cost of equipment for repairs.

\(^{22}\) The high cost of ox carts in tropical Africa appears to be due primarily to the fact that no African artisans have been trained to make the wheels which are the most costly part of the cart. This calls attention to the importance of training rural artisans which we have stressed elsewhere in the report.
and spares. Every individual farmer, however, does not need to have his own draft animals and equipment, and particularly a cart, the annual cost of which amounts to about $16. If the owner can perform contract services for other farmers, or rent out his animals and equipment, the annual cost which one farm has to bear is considerably reduced. In the Cameroons it has been estimated, for instance, that one plow can be made to suffice in this way for three or four farmers, and one cart for as many as ten farmers. What will be feasible in this respect will, of course, depend to a large extent on the local circumstances.

Animal-drawn equipment is on the whole better adapted to the size of the holdings and the capacity of individual African farmers. Admittedly many African farms cannot even make full use of animal-drawn equipment either because they are not large enough or because the cultivated area is limited by the time required for weeding or harvesting operations that must be done by hand. However, in many parts of Africa farmers have found it possible to get more use out of their equipment by doing ox plowing for their neighbors on a contract basis. Here and there, as in Mali, cooperatives have also acquired oxen and implements for the purpose of lending these to members. In the Bokoro region of the Chad efforts have also been made to encourage cooperative ownership of implements. It must be admitted, however, that cooperatives may experience difficulty in resolving conflicting demands for draft animals and implements, particularly since their members generally all want to use them at the same time.

The use of draft animals is sometimes conceived of as only one aspect of a gradual process that would associate livestock more intimately with agriculture, diversifying production and consumption by the addition of meat and milk, improving crop rotation by incorporating the cultivation of fodder and producing manure for replenishing the fertility of the soil. Often particular stress has been put on the production of manure, although in practice this has proved to be especially difficult. Admittedly, the use of animal manure is very valuable where soils are poor in humus and do not respond readily to chemical fertilizers or where green manure is not effective in replenishing soil humus. Farmers usually do appreciate the value of compost or manure, applying such household waste or manure as may be available to the fields near their huts. However, they have found it difficult to produce well-rotted manure in adequate volume. Considerable quantities of litter must be collected, and, it is highly desirable to have water available for irrigating the manure periodically during the dry season. Often ten to fifteen tons of manure must be applied
per hectare (ca. four to six tons per acre) in order to get significant results.\textsuperscript{23} A cart is almost indispensable for transporting the needed litter and taking the manure to the fields.

In most areas where animal traction has been adopted little or no real farmyard manure is in fact produced. Experience indicates that a persistent and well-conceived campaign is necessary to get farmers to adopt this practice. We noted, for example, that the CFDT, which was promoting cotton growing and carrying on general agricultural extension work in the dry-farming areas of Mali, had made some progress in encouraging the production of manure since 1960. Yet even here the achievements had proved rather disappointing. In 1964/65 only some 3,250 pits and platforms were actually being used for making manure, even though a far larger number had been constructed over recent years. In one area 40 percent of the cotton crop was said to have been manured in 1964, but the overall average was only 8 percent.\textsuperscript{24} At the same time the quantities of manure applied were obviously far below the total recommended. The original insistence on making the supply of chemical fertilizers dependent on the prior use of manure had to be abandoned. A number of reasons probably accounted for the limited success. Many farmers may well have considered the work involved too laborious. Such an attitude may have been encouraged by the fact that of all the items of equipment available for sale to farmers, carts have been in shortest supply. Difficulties were encountered, too, in draining manure pits and platforms and in protecting them against rain so that farmers were generally reluctant to keep their cattle there during the rainy season for fear of disease. Thus the expectation that each head of cattle could produce at least two to three tons of manure per year was apparently far from realized.

\textit{Some disadvantages}

The disadvantages of animal traction should also be considered. One relates to the problem of feeding livestock during the dry season. Draft animals are expected to work hardest at the beginning of the rainy season after their strength has often been depleted by the inadequate grazing available during the preceding dry season. In the

\textsuperscript{23} In the dry farming areas of Mali the application of ten tons of manure to one hectare of cotton is recommended and has been shown to produce an increase in yield of 400 kilograms. In the Machakos District of Kenya we found that the agricultural service was recommending the application of five tons per acre of cotton and ten tons per acre of potatoes.

\textsuperscript{24} See the case study, “Mali: The Development of Peasant Cotton Production by the Compagnie française pour le développement des fibres textiles,” in Vol. 2.
Central Nyanza District of Kenya, for example, we were impressed by the number of farmers who complained that their animals had fallen sick or died during the plowing season. Because of insufficient feeding, draft animals are seldom capable of plowing more than three to four hours per day. The practice of growing feed for cattle or of accumulating feed reserves for the dry season is still largely unknown. In theory it should be possible in many areas to cut and gather grass during the flush season for storage and use in some form during the dry season. This requires, however, a revolution in habits and thinking which can at best be brought about only by persistent, continued efforts. As in the case of manure making, it implies the availability of a cart and, besides, the introduction and use of certain implements such as sickles and forks which are not generally known in tropical Africa.

The limited tractive power of animals is another drawback. Unless soils are very light, draft animals cannot be used to plow land in advance of the rains so as to facilitate early planting. They have great difficulty in coping with the heavy clay soils (for example, the so-called black cotton soils) found in some parts of Africa even when as many as six oxen are hitched to the plow. They can hardly be used, too, in breaking land that has been under thick grass, such as the rhizomatous Kikuyu grass (*Pennisetum clandestinum*), or that has become infested by such weeds as couch grass (*Digitaria scalarum*).

Finally, the quality of land preparation with animal-drawn implements often leaves something to be desired. In Central Nyanza, for example, we found a number of farmers who, after having their land plowed at various times under contract by both tractors and oxen, expressed a definite preference for tractor plowing despite its somewhat higher cost. On the Mwea-Tebere irrigated rice-growing scheme the abandonment of ox plowing in favor of tractor-mounted rotavators is reported to have resulted in substantially better soil conditioning and considerably higher yields. However, in both these areas the soils were rather heavy and difficult to work. Over much of tropical Africa the soils are such that they can be worked rather adequately by animal-drawn implements.

**Conditions of success**

Despite some of its disadvantages and difficulties animal cultivation is widely practiced in many parts of Africa such as portions of Uganda, Tanzania, Kenya, Zambia, Mali and Northern Nigeria, to

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Implement and Machinery

name only a few. It has made a considerable contribution to agricultural development, primarily by expanding the area under cultivation in such a way that cash crops could be grown in addition to subsistence crops. Thus the ox plow has been greatly instrumental in facilitating and expanding the cultivation of cotton in all the areas mentioned above.

On the basis of experience, the principal conditions conducive to successful adoption of animal traction can be set forth. First of all, farmers should have some livestock tradition and a familiarity with animals. This may not be an absolutely indispensable condition, but it is obviously much more difficult to get animal traction adopted by people who traditionally have owned no livestock or who are not accustomed to handling them because, as in some parts of West Africa, they entrust them to another tribe for herding. In the region around Bouaké in the central part of the Ivory Coast we noted efforts to introduce the use of draft animals among the Baoulé, who are not a livestock people. While these were not necessarily foredoomed to failure, it was easy to perceive that progress would in any event be painfully slow. The second condition is the availability of sufficient grazing land. This is, of course, indispensable, at least until the still rather distant day when a significant number of Africans can be induced to grow fodder crops. A part of this condition is that the grazing land has no alternative, more profitable employment. For instance, it would obviously be unwise to recommend ox plowing in the highlands of Kenya where pasture can support a much more productive dairy animal. It should also be noted that population pressure may eventually make animal traction uneconomic in some of the areas where it is now used unless farmers can be enabled and persuaded to include a high-yielding fodder in their crop rotation and thus to reduce their reliance on natural grazing. Finally, there must be no serious threats to the health of draft animals which cannot be readily controlled. It hardly pays to push animal traction in areas infested by tsetse fly, unless as in parts of West Africa, there are types of cattle, such as the N'Dama, which are relatively resistant to trypanosomiasis.

Need for further development work

Today there is a tendency in Africa to discount the desirability of animal traction and the scope for its further expansion. “Modernization” of agriculture through mechanization undoubtedly is more appealing and glamorous, but the many failures and waste of resources that have attended precipitate mechanization should dictate caution. The problems involved in the effective use of animal-drawn
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implements and the association of livestock with agriculture are undoubtedly many, but they should not be dismissed too readily as being intractable. It must be kept in mind that the adoption of animal traction is still a comparatively recent phenomenon in tropical Africa. While the operation of animal-drawn equipment poses far less serious management problems than that of tractors, this does not obviate the need for careful and persistent training. It is obvious that more time and also additional tools will be necessary if, in the long run, progress is to be made in the production of manure or in the gathering and storage of fodder for use in the dry season. But the more immediate and practicable need is to improve the efficiency with which animal-drawn equipment is employed. Inadequate training has resulted in poor cultivation and excessive employment of labor. It is normal, for example, for three and even more people to be engaged in handling a single ox plow—one to guide the implement, one to lead the oxen and still another to prod the animals; and even then the standard of operation is low. One of the principal difficulties is that the animals do not stay trained because they are normally harnessed only for the brief plowing season. They would become more tractable and efficient if they were used more continuously for pulling a cart and drawing a cultivator as well as a plow.

In many areas insufficient attention has been devoted to the testing of various types of implements and equipment to determine their suitability to local conditions.27 It is only in comparatively recent years that efforts have been made to devise equipment which is specially adapted to conditions in Africa and sufficiently cheap to merit adoption. Some progress appears to have been made in developing more versatile implements.28 However, the efforts to develop a sturdy mobile toolframe on which equipment can be mounted to carry out a wide variety of operations such as plowing, ridging, seeding, weeding and transport29 have not in practice proved successful. Work on the improvement and promotion of animal-drawn equipment should be expanded rather than abandoned. Its potential benefits would be considerable and its occasional failures would at least not entail the substantial waste of resources that unsuccessful mechanization may cause.

27 We noted this particularly in certain parts of Kenya such as Central Nyanza and Machakos, but it is undoubtedly true of many other areas in Africa as well.
29 For a description of these development efforts, see D. F. Howsar, R. G. Chalmers and R. H. Marsden, “Some Projects to Assist the Mechanization of Agriculture in Developing Countries,” World Crops, June 1963.
Mechanization

Mechanization has a number of advantages which favor its adoption under certain conditions. These include, as we have indicated already in part, greater speed of operation, more thorough land preparation and the capacity, because of greater tractive power, to cope with harder and heavier soils, turn in green manure and break heavy grassland. It has often been argued, too, that with progress in education farming will tend increasingly to be neglected unless it becomes more mechanized, simply because educated people will not take to the drudgery of the hoe or even of ox cultivation. While this is undoubtedly true, it does not eliminate the need to make sure that the benefits of mechanization outweigh its costs.

Indeed, experience shows that the primary problem is to keep costs within manageable limits. Such limits are rather restrictive because the farm value of crops per unit of area is in many cases too low to support high production costs per unit of area. A number of factors tend to make mechanization costs excessive:

1. the high proportion incurred in foreign exchange;
2. difficulties with maintenance and repair;
3. the need for thorough land clearance; and, above all,
4. the problems involved in securing sufficiently full utilization of mechanized equipment. Each of these will be discussed in turn.

Foreign exchange costs

The purchase of mechanized equipment and recurring expenditures on fuel, oil and spares may impose a severe burden on the balance of international payments. For African countries that suffer chronic balance of payment difficulties, the rate of exchange at which the cost of imported equipment and supplies are valued frequently does not reflect the scarcity of foreign exchange. Under such conditions the nominal cost of equipment and supplies may substantially understate their true cost to the economy. It then becomes especially important to ensure that mechanization will really result in substantial increases in agricultural output which would other-

wise have been impossible and which in turn directly or indirectly relieve the balance of international payments.\textsuperscript{31}

Repair and maintenance costs and the problem of subsidies

While the prevailing foreign exchange rate may understate the cost of mechanization, the long-run costs of repair and maintenance may well prove considerably lower than those that now obtain. The comparatively high cost of maintenance and repair is at least in part due to factors which can in the end be overcome. The current low level of skills, inadequate training of drivers, mechanics and other personnel, and the poor organization of maintenance and repair services need not be permanent features of mechanization. Where repair services tend to be poor or high in cost because there is still not sufficient mechanization to warrant the organization of efficient services, that too can be considered a temporary handicap.

Just as the "protection" of "infant" industry may be justified on the ground that high costs of production are only temporary, so also can a "temporary" subsidy of repair and maintenance costs in the early stages of agricultural mechanization be justified. At the same time the danger that the inefficiency or high costs may be perpetuated by such a subsidy is clear. Very often timely measures to prevent the emergence of excessive costs can be taken, but are neglected. In Sukumaland, for example, we witnessed the beginning of an effort at mechanization on a considerable scale after only the most cursory training of tractor drivers and without thorough advance organization of repair facilities. In the Office du Niger in Mali, repair shops and repair work appeared still to be very inefficiently organized despite the many years that had transpired since the inception of mechanization. On the other hand, in the Gezira Scheme in the Sudan, repairs seem to be on the whole efficiently managed after many years of experience.

High initial costs on mechanization schemes may to some extent also be due to the need for employing expatriates as shop supervisors, mechanics and, more generally, as managers of the whole operation. The services of such expatriates are generally expensive, so that with the gradual training of local replacements costs can be reduced, provided, of course, there is no accompanying drop in efficiency.

\textsuperscript{31} Difficulties of determining the "true" foreign exchange rate at which imports ought to be valued obviously complicate the task of estimating the real "economic" cost of mechanization. However, if the net benefits of mechanization are not very marked when costs and benefits have both been calculated at unadjusted nominal or market prices, they may well be shown to be non-existent if prices are adjusted only partially and well within the permissible range suggested by the extent of over-valuation of the foreign exchange rate.
The burden of land clearance

We have already stressed the importance of complete clearing of land if excessive breakage in the use of mechanized equipment is to be avoided. In some parts of Africa land is sufficiently free of bush and trees that little or no clearance costs need be incurred. However, areas of this type are often characterized also by marginal rainfall which may make crop output so unreliable as to endanger the regular recovery of mechanization costs. In most parts of tropical Africa costs of clearance tend to be rather high. Such costs vary not only with the density of the bush and tree cover, but also with the efficiency of the clearing organization and methods used. In Tanzania, fully mechanized clearing of land for the ill-fated post-war groundnuts scheme cost Sh 290 ($40.60) per acre at Kongwa and Sh 348 ($48.72) at Urambo. In the Mokwa scheme in Northern Nigeria land clearance, done by hand and with paid labor, cost £11–£13 ($30.80–$36.40) per acre. More recently the clearing of large areas of land devoted to state and cooperative farming in Ghana has apparently entailed costs of between £15–£40 ($42–$112) per acre. Such heavy initial investment cannot usually be borne by crops with a low value per unit of area.

In some cases it has proved possible to avoid such costs by insisting that farmers benefiting from mechanization clear their own land. This was done in a pilot mechanization scheme that was initiated in the Central African Republic in 1956; and the condition appeared to have contributed significantly to the success of this project. On a somewhat similar scheme, which was started in the Congo during the 'fifties and has also shown some promise, the participating

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32 This is true, for example, of part of the highlands of Kenya, the Kano Plains in Kenya, part of Sukumaland in Tanzania, and a considerable area in the rainlands of the Sudan.
33 In the Gambalaye-Gedaref areas of the Sudan where mechanization of sorghum cultivation has been successfully carried out on marginal rainlands requiring little clearance, the “farmers” have in fact been merchant-farmers who till their land in units of over 1,000 acres and can apparently take in their stride losses due to periodic bad harvests. Small farmers sharing in a group mechanization scheme could not be expected to bear such risks.
34 About CFA francs 25,100 per hectare.
35 About CFA francs 20,100 per hectare.
37 About CFA francs 17,300–22,500 per hectare.
38 About CFA francs 25,700–69,200 per hectare.
farmers were likewise required to carry out preliminary land clearing themselves. In Sukumaland communal work groups have been used to do whatever land clearance was necessary for the block mechanization schemes that were initiated in 1964.

Insistence on such a condition is hardly practicable when mechanization is intended to put under cultivation large tracts of land that have hardly been farmed before and carry a sparse population. In areas already being cultivated, such a requirement does undoubtedly slow up the pace of mechanization because hand clearing is an onerous task unless, as in much of Sukumaland, the bush cover is rather light. However, it has the merit not only of reducing costs, but also of testing the farmer’s willingness to work in order to get the benefits of mechanization. Mechanization is unlikely to be economic unless the farmer understands from the beginning that it is not designed to lighten his total work burden but rather to enable him to work more and produce more.

Fixed costs and the problem of adequate machinery utilization

The cost of mechanization per acre or hectare is largely determined by the extent to which equipment can be utilized and by the machinery time required per unit of land area. The capital cost of mechanized equipment and the high fixed costs involved in its operation make the fullest possible utilization necessary. While a part of fixed costs may be occasioned by certain overhead outlays on supervisory and operating staff and on repair facilities which must be covered irrespective of the rate of utilization, the most important element is the depreciation of tractors and implements. The life of machinery and therefore depreciation charges can, of course, be affected by the care with which it is operated, maintained and repaired. The life over which equipment must be depreciated can be expressed in terms of both hours of operation and of a specific number of years. In the first case depreciation charges for each hour of operation are the same, and annual depreciation charges are a function solely of the number of operating hours. In the second case, a fixed annual depreciation charge is incurred irrespective of the number of hours of operation. The life of equipment is in practice limited to a definite number of years not only because equipment

40 In 1960/61 around 1,000 hectares were mechanically cultivated on three paysannats—Luala, Maunzi, Mvuazi—all located in the area between Matadi on the coast and Leopoldville. See Société d'Études Agronomique et de Réalisations, Une expérience de développement rural accéléré en région tropicale: le Groupe d'Économie Rurale (Communauté Économique Européenne, Fonds Européen de Développement, 1963).
tends to become technically obsolescent, but also because corrosion and other factors cause deterioration independent of use. In theory it may be desirable to make separate charges for each type of depreciation, but in actual practice this is seldom considered feasible. In general, the life of machinery is not expected to extend beyond a fixed number of years and there is thus a minimum annual depreciation charge which must be apportioned among the number of hours the equipment has actually been used during the year. For example, a light to medium tractor which might be capable of 5,000 to 6,000 hours of operation would in any event not be expected to last beyond five to six years and, therefore, would incur a minimum annual depreciation charge of one-fifth to one-sixth of its original cost.

With high fixed costs, hourly costs of operation tend to decline significantly as the period during which the machinery is utilized increases. The decline in hourly costs tends to be particularly marked as the rate of utilization rises from 250 hours to 750 hours per year. Experience indicates that it is very difficult to make mechanization pay unless a tractor can operate at least 500 hours per year. Conditions often make it impossible to achieve this rate of utilization. There may be insufficient land available for mechanical cultivation within a reasonable distance. A tractor cannot usually be justified unless it can be used to cultivate 125–200 acres. Soil and climate conditions may severely restrict the period in which a tractor can work; and there may be no opportunity to use the tractor for more than one mechanical operation. On the other hand, conditions may make it possible to extend the period during which tractor operations are feasible. On the Sudan Gezira scheme, for instance, the management can operate its tractors as much as 1,900 hours per year because they are used primarily for ridging and fallow cultivation which can be done over a long period during the dry season. In the Office du Niger, too, ridging can be done during the dry season so that a single tractor can work a considerable number of hours. On

41 Lord depreciates three-fifths of the cost of tractors over a fixed period of years, and the balance in accordance with operating hours, calling the first "obsolescence" and the latter "wear and tear" depreciation. Drachousoff makes the same distinction, but fixes annual depreciation for obsolescence at only 4 percent of the value of equipment. The difference in weight given to these two types of depreciation illustrates the rather arbitrary results that this method can produce. See Lord, Economic Aspects of Mechanised Farming at Nachingwea in Tanganyika, pp. 178–179; also, Une expérience de développement rural accéléré en région tropicale: Le Groupe d’Economie Rurale, p. 253.

42 See "Quelques données simplifiées sur le calcul des prix de revient d’utilisation des matériaux agricoles dans les pays agricoles," Machinisme Agricole Tropicale, October–December 1963, No. 4, particularly p. 28.
irrigation schemes the control over water supply often makes it possible to extend cultivation operations over a longer period, thus securing better utilization of machinery. In some areas ecological conditions permit two cropping seasons or allow a range of crops which can be sown at different times, thus prolonging the period during which cultivation operations can be carried out.\textsuperscript{43} Finally, it may be possible to use tractors for noncultural operations such as spraying,\textsuperscript{44} transport and maize grinding. However, employment of tractors for such purposes must always be weighed carefully in relation to other means available for carrying out these tasks.

Operating costs per acre or hectare are more meaningful, of course, than costs per hour. The economics of mechanical cultivation is thus critically determined by the number of cultivation operations and the number of hours required for each. These in turn depend on the nature of the soil and of the crop. In some cases as many as three different operations may be necessary to prepare a proper seed bed. In other cases one or two operations may suffice. Where land needs to be ridged, it is plowed before ridging in some areas, but directly ridged in other areas. In the Gezira scheme, cotton land is ridged during the dry season without preliminary plowing, but after the advent of the rains these ridges are then split and formed into new ridges in order to facilitate germination and subsequent rooting in the heavy cracking clays characteristic of this project area.\textsuperscript{45} On the other hand, in the Office du Niger only a single ridging operation is carried out.\textsuperscript{46} Other examples can be cited. Thus on Mwea-Tebere,\textsuperscript{43} On the pilot mechanization scheme in the Central African Republic to which we already have referred it is possible to use tractors over a considerable time because groundnuts are sown in March–April, maize and other food crops in April–May, cotton in May–June, and rice or sesame in July. In 1964 operating hours per tractor averaged 708. (See Morel and Mercy, "Un exemple de mécénisation en agriculture centrafricaine: la CUMA de Grimari," \textit{Machinisme Agricole Tropical}, January–March 1964, No. 5; and private communication.) On an experimental mechanized farm at Nalumuli in Uganda, where there are two cropping seasons, it was found that operations could be spread over a long period since maize is sown in January and February, groundnuts in March, cotton in June and beans in August. There are two tractor utilization peaks—one in December–March when land is broken and prepared for maize and groundnuts, and a subsidiary one in June–July when land is reridged and planted to cotton, groundnuts are dug and land is prepared for beans. Tractor utilization on an arable area of 90 acres was extended in this way to about 660 hours per year. (See J. D. Lea and J. L. Joy, "Modern Arable Farming in Uganda," \textit{The Empire Journal of Experimental Agriculture}, Vol. 31, April 1963.)

\textsuperscript{44} On the Perkerra irrigation scheme in Kenya the use of tractors for spraying onions as well as for staggered land preparation has reportedly made it possible to use tractors, on the average, 2,000 hours per year.

\textsuperscript{45} We have already noted that this also helps to bury the first growth of weeds.

\textsuperscript{46} On the Nalumuli trial mechanized farm in Uganda it has also been demonstrated that ridging is the only land preparation necessary except when cotton
an irrigated rice scheme in Kenya, it has proved possible to prepare land thoroughly in a single operation with a rotavator mounted on a tractor; but in certain other rice-growing areas such as the Office du Niger in Mali and the old Richard-Toll scheme in Senegal two or three land preparation operations are evidently considered necessary.

There is a wide range in the time required for different types of land preparation and, therefore, in the cost per acre. It may take up to three or four hours per acre to plow fallow land with a two-furrow plow, but only as little as 0.2 hours per acre to do disc harrowing. In the Sudan mechanized cultivation of dura on rainlands has proved economic largely because the land needed to be worked only to a depth of 2 to 2.5 inches and land preparation could be confined to two operations carried out with a 16-foot disc tiller at a total cost of no more than Sh 20–30 ($2.80–$4.20) per acre.

In the final analysis the economics of mechanization will be determined by translating the cost of mechanical operations per unit of area into a cost per unit of output. The higher the value of the crop per acre or hectare (net of all costs other than mechanization), the greater are the mechanization costs it can bear for the same unit of area.

Mechanization of individual farms

Individual African farms are seldom large enough to make profitable use of a tractor which, together with a minimum number of implements, is likely to cost $4,000 to $5,000. In the highlands of Kenya and Tanzania there are a number of such farms, mostly devoted to wheat growing which lends itself to mechanization at all stages ranging from land preparation to harvesting and threshing. In the Sudan, as we have already indicated, merchant-farmers grow dura (sorghum) on farms of around 1,000 acres. Here land preparation and sowing are mechanized, but weeding is still done by hand and only a small portion of the crop is combined by machine, owing to difficulties encountered in developing palatable sorghum varieties which can also be harvested mechanically.

The ownership of tractors and implements by individual African farmers for exclusive use on their own farms is likely to remain rather atypical. For the most part mechanization is possible only where:

follows a grass ley, in which case plowing is necessary. See Lea and Joy, "Modern Arable Farming in Uganda," The Empire Journal of Experimental Agriculture, Vol. 31, April 1963.
1. contract services are provided by governments or private individuals to farmers who themselves cannot afford their own equipment,
2. land formerly farmed in scattered holdings can be pooled for mechanized cultivation,
3. organized settlement schemes, including irrigation schemes, permit the management to provide certain mechanical services to participating farmers, or
4. large state or collective farms have been established.

Private contract services

In East Africa there are a considerable number of private contractors who undertake to carry out specific mechanical operations at set rates. They are usually farmers or farmer-merchants who have developed a contracting business incidental to the use of machinery on their own land.

Private contracting undoubtedly has some marked advantages. The machinery owners have an interest in keeping costs down. They can set their own rates and decline, if necessary, to do contract plowing on small or distant fields which is generally quite costly. The business and technical skills they develop in operating their tractors ultimately redound to the benefit of the economy as a whole. On the other hand, many of them come to grief. They often do not reckon with the high cost of depreciation and find it difficult to cope with maintenance and repairs. In many cases poorly trained drivers are employed and adequate maintenance is sacrificed in the interest of short-sighted economics. Frequently, contractors cannot get enough business without going excessive distances or building up a large clientele of smallholders to the detriment of economic and timely operations. A considerable proportion of tractors tend to fall into disrepair, and many tractors sold on credit are repossessed owing to failure to keep up payments.

However, it is often not known with any certainty just how private

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47 At Ukiriguru Research Station in Tanzania we were told that a survey of private tractors in Sukumaland had shown that 32 out of 186 tractors were out of commission, primarily for want of spares. A worse situation was disclosed in two areas in Uganda by a field investigation conducted in 1964 by a Makerere University College student. He found that (1) only 28 out of 49 tractors appeared to be in working order, (2) the number of hours that tractors operated during the year was in most cases completely inadequate, and (3) none of the farmers had the ability or commercial sophistication to make effective use of tractors. See Olwoc Salvatore Yoanna, “Ownership and Use of Tractors by Small-Scale Farmers in West Acholi and Mengo District, Buganda” (B.Sc. thesis, MS, Makerere University College, 1964/65).

48 In Nairobi one tractor distributor claimed in 1964 that he had been compelled to repossess 47 out of 50 tractors sold in the Mwanza District of Tanzania over the preceding two years.
tractor contractors do fare and whether, in any given area, they are making progress in improving their operations. Few attempts have been made to study the problem and to determine what can be done by government, with the help of machinery distributors, to provide contractors with better repair services and technical advice. In some areas private contracting seems to have achieved a considerable measure of success. The largest concentration of private African tractor operators is found in the Sudan Gezira scheme. There the management of the Gezira scheme has left certain cultural operations, including the splitting of ridges and a subsequent reridging operation, entirely to private tractor operators. These operators who are farmers or merchant-farmers apparently own well over 600 tractors which probably average around 750 hours' work per year and most of which are said to earn a profit for their owners. In Kenya contract services are being operated, apparently at a profit, by both Europeans and Africans in African areas adjoining European farms and on former European farms settled by Africans. The rates charged per acre vary somewhat, but they are generally Sh 40–50 for breaking fallow land, Sh 30–40 for plowing old arable, and Sh 15–20 for disc harrowing. From the experience in the Sudan and Kenya it appears that private tractor contracting can prove profitable under conditions where:

1. a considerable demand for mechanized services has developed,
2. experience in the operation of machinery has been acquired, and
3. the number of tractors in use justifies the provision of adequate repair and servicing facilities.

It is probably also true that the contractor who has had some previous business experience such as in shopkeeping or transport is likely to be more successful than others.

Government contract services

Many government contracting schemes have been tried, but virtually all have failed to cover costs of operation and have had to be abandoned or continuously subsidized. The amount of machinery used and the scale of operations do make it easier in principle to provide better management and repair services for such schemes.

49 This does not necessarily mean that farmers are always well advised to use these services. On some settlement schemes in Kenya the settlers are apparently incurring expenditures and debts for mechanical plowing when they themselves are underemployed and could easily work by hand the few acres that they crop.

50 This was the conclusion of the survey of private tractor contractors in Sukumaland which was made by the agricultural engineer at Ukiriguru Research Station and which has already been mentioned in a previous footnote.
On the other hand, they often cannot collect from farmers, or governments require them to operate at excessively low rates; and the volume of business is usually insufficient to meet both the operating cost and the overhead cost of repair shops and management supervision.

The experience of the contract plowing scheme operated by the Department of Agriculture in Uganda is probably typical. Although this service seems on the whole to have been efficiently managed, it was unable to cover even half of its cost during the years 1960 to 1962 inclusive. Its charges per acre were (in 1962) Sh 45 for first plowing, Sh 40 for second plowing and Sh 25 for disc harrowing, but this proved insufficient since its costs averaged close to Sh 40 per hour, and it required around 1.9 and 1.25 hours respectively to plow and disc one acre of land. Moreover, nearly 20 percent of the operating time and costs was incurred by travelling to and from fields. By 1963 it was concluded that the scheme could work, if at all, only if farmers could be induced to group their fields in such a way that large blocks could be cultivated at one time.51

A limited number of rather special contract schemes focusing on mechanized land preparation in lowland rice-growing areas of West Africa appear to have had some success. In this part of Africa there are many riverine and river delta areas which are flooded annually and can be used to grow rice. Often there is insufficient manpower to prepare any significant area by hand or by ox plowing,52 all the more because there is only a limited amount of time for plowing the land and the plowing period often coincides with that required for work on other crops. The danger of weed growth makes it difficult to prepare the land too far in advance of the floods. Sowing usually takes place during the beginning of the rainy season, and the land is then inundated by the river, sometimes with some control over the rate and level of inundation. In Nigeria, Sierra Leone and Senegal mechanized land preparation services have been furnished for schemes of this type.

Apparently the most successful of these schemes has been on the Jere Bowl near Maiduguri in Bornu Province of Nigeria. There rice

51 Some government contract plowing schemes have fared considerably worse. In 1961, for example, an upland tractor contracting scheme was started in Northern Nigeria. Originally the charges covered only 25 percent of the costs. When the subsidy was cut to 50 percent in 1962 and the minimum area that would be plowed was raised to 2 acres, use of the service fell off significantly and was largely confined to salaried people such as chiefs and other civil servants who were not very sensitive to costs. Apparently the ratio of expenditures to costs remained at about 4:1. See Stokes, “Mechanization and the Peasant Farmer,” World Crops, December 1963.
52 In these areas the keeping of oxen is often inhibited also by trypanosomiasis.
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is grown by farmers on the flood plains of the Alo River, with the Bornu Native Authority providing the contract plowing services. The scheme was started in 1954 and by 1962 covered 2,659 acres. At yields of 0.9 tons of paddy per acre, rice production is reported to have proved quite profitable after allowing for the cost of mechanical land preparation (Sh 76 or $10.64 per acre) and other costs. On the other hand, the Shemankar rice scheme in the Lowland Division of Nigeria's Plateau Province seems to have been uneconomic apparently because plowing costs were much higher and rice yields considerably lower. The fact that one-eighth of the operating time of machinery was taken up by moving from one basin or "fadama" to another evidently added considerably to the cost. Still another Nigerian scheme of this type—the Sokoto (later Gwandu) Mechanized Rice Scheme—was once the largest of its kind, attaining 25,000 acres in 1951/52. However, it proved to be the most serious failure, largely because damage due to uncontrolled flooding and to fish brought paddy yields down below 1,000 lbs. per acre.

In Sierra Leone the government contracting service which carries out plowing and harrowing on swamp and riverine rice areas has apparently never paid. Recent estimates of actual cost per acre are not available but are probably in the neighborhood of Sh 90–100 ($12.60–$14.00) as compared with a subsidized rate of Sh 60 to the farmer. It is possible that mechanical cultivation is nearly economic on the deep-flooding grasslands which are generally more fertile than the shallow-flooding inland plains (so-called boli areas) and may produce on the average 1,500 lbs. of paddy per acre. In the Senegal River delta, mechanized preparation of land for individual farmers growing rice has been reported to be a success. Here yields are said to be 1,500 kilograms of paddy per hectare or 1,340 lbs. per acre, and cultivation costs are put at 6,000 CFA francs per hectare or about $10 per acre.

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54 For information on this scheme we are indebted to an unpublished manuscript of Baldwin, *Large-Scale Schemes in Northern Nigeria*.

55 See the annual reports of the Department of Agriculture, Sierra Leone; also A. J. Carpenter, "Objectives and Methods in Rice Breeding and Selection in Sierra Leone," *CCTA Symposium on Rice*, Conakry, 1963.

56 See Ly Bocar, "La Riziculture dans la Vallée du Fleuve Sénégal," *CCTA Symposium on Rice* (Conakry, 1963). According to Bocar, 1,500 kilograms of paddy produce a revenue of 27,000 CFA francs per hectare at 17 francs per kilogram. After deducting 6,000 francs for plowing and 2,500 francs for seed, the balance of 18,500 francs left per hectare as a return to land and labor is superior to that of 9,000 francs which is said to be received under similar ecological conditions from one hectare of millet or groundnuts.
Mechanized group or block farming

We have already noted that the difficulty of ensuring economic operation of contract mechanization schemes under the normal pattern of individual farm holdings has produced efforts to pool land for mechanical cultivation. Such efforts entail temporary or permanent changes in land tenure which may not be easy to accomplish unless land is still rather plentiful and homogenous in quality and individual rights in land have not developed to such a degree that people are reluctant to give up their rights to individual parcels in exchange for other land. Under schemes of mechanized "group" or "block" farming, a central organization, usually taking the form of a cooperative, provides certain services such as mechanical cultivation, but the individual farmer holding land in the block retains responsibility for all other operations and is entitled to the proceeds of the harvest on his land subject to deductions for the services he has enjoyed.

Over recent years this type of scheme has been tried in both Uganda and Tanzania on a considerable scale. In Tanzania no less than 129 tractors which the Government had bought on credit were turned over to the Victoria Federation of Cooperative Unions in 1963 and 1964 for use on block farms to be established for the production of cotton in Sukumaland. The introduction of mechanization was to be accompanied by intensification of production, involving the application of fertilizers and insecticides in the hope of achieving yields that would provide an attractive net income after meeting all costs. The organization of block farms was launched in 1964, with workers of the TANU political party playing an important role in persuading farmers to pool their land and participate. Each farmer was generally expected to get about four acres of land in a block farm.

Elsewhere we comment in some detail on these schemes, recognizing that it is much too early to pronounce any final judgment. We have emphasized that there is a case for trying mechanization in Sukumaland and also for testing the block farming approach to mechanization. It is certainly conceivable that mechanization will prove its worth for at least some parts of Sukumaland. It would have been possible, however, to start on a more modest scale which would have made it easier to cope with the managerial and technical problems involved and to minimize the risk of eventual losses. Experience in the first year—1964/65—revealed that the magnitude of the problems had been seriously underestimated. Moreover, the

concentration on raising cotton production through mechanization accompanied by intensification appears to ignore the diversity of conditions in Sukumaland and the alternative potentialities of ox cultivation.

The block farming schemes in Tanzania are wholly devoted to cotton growing. Participating farmers thus retain individual holdings outside these schemes for other crops, particularly their food crops. There is some evidence indicating that with the help of fertilizers cotton can be continuously cultivated on the same land for a long period. Should some form of rotation either with other crops or with fallow prove to be necessary, then new land for cotton would have to be pooled periodically or the present block schemes would have to be enlarged to include other crops in a regular rotation.\(^5^8\)

Certain other approaches differ from the course followed in Sukumaland in that they have been undertaken on a much smaller scale and have made provision for a complete crop rotation. Thus land is more or less permanently pooled and redivided, with every participating farmer having a share in the land devoted to each crop. Passing reference to two schemes of this type has already been made earlier in this chapter. One of these was initiated by the autonomous Groupe d'économie rurale (GER) during the 'fifties in that part of the Congo lying between Matadi and Leopoldville; the other was started in the 'fifties in the Central African Republic by the agricultural research station at Grimari and was transformed into a cooperative — Cooperative d'utilisation du matériel agricole de Grimari (CUMA) — operating under the general supervision of the research station. Here we shall deal briefly only with CUMA, since the GER's projects have suffered considerable disruption as the result of conditions in the Congo during recent years.

We have already mentioned that participation by farmers in the CUMA scheme was conditioned on the prior clearing of the land contributed to the scheme and that the land was laid out for cultivation in narrow bands with provision for soil conservation. The rotation, which was devised after some experimentation and involved certain, but not radical, modifications in customary land use patterns, provided for the following crops: 0.7 hectares of cotton in the first year; 0.7 hectares of groundnuts, followed by the same area in rice or sesame, in the second year; and 0.7 hectares of mixed traditional crops in the third year, with cassava carrying over in the

Even if land can be continuously cropped to cotton, it might still be useful to regroup land devoted to food crops in such a way as to reduce the distance separating the cotton land and the other land tilled by each participant in the scheme.
fourth year; and fallow in the fifth and sixth years. Thus there was provision for a maximum of 2.8 hectares (6.92 acres) in crops, including double cropping in the second year. Fallow was greatly curtailed not only because of the use of fertilizers on cash crops, but also because of the fear that fallowing for four years or more would produce too heavy a regrowth of trees and bush. Mechanization operations were confined to the preparation of land for the cash crops to be grown during the first two years of the rotation, thus leaving the traditional food crops to be tilled by hand and in the customary mixtures. Mechanical land preparation was kept as simple as possible. The initial breaking of fallow for the first year crop of cotton involved fairly deep plowing followed by disc harrowing. For subsequent crops lighter plowing with a seven-disc plow proved sufficient. By 1965 it was possible to utilize the five tractors on the scheme for an average of 708 hours.

A feature of the scheme has been its slow but steady growth since it was first started in 1956. In 1964 the area under mechanized cultivation reached 578 hectares (1,428 acres) of which 223 were devoted to cotton, 197 to groundnuts and 158 to rice and sesame. The number of families participating was 356, and of these 202 had reached the stage where they were practicing the complete crop rotation outlined above. The average mechanized area per family was 1.62 hectares. A 1964 sample survey of farmers inside and outside the scheme disclosed that mechanization apparently enabled farmers to increase the total cropped area, particularly that devoted to cash crops. By comparison with “traditional” farmers, “mechanized” farmers grew 40 percent more cotton and 44 percent more groundnuts in terms of area per family, and 22 percent more of both cotton and groundnuts in terms of area per active worker. They were able to get substantially higher cotton yields, apparently as the result of better land preparation as well as the use of fertilizers and insecticides. The mechanized farmers seem to have enjoyed a higher net output after allowing for all the costs of mechanization and the expenditures on fertilizers and insecticides.69

The progress achieved by CUMA of Grimari has avoided costly mistakes, but it undoubtedly has been slow. Pressure seems in fact to have built up in favor of a rapid acceleration, which might well endanger the principle of prior land clearance by the farmers themselves and quickly run into organizational and technical difficulties.

69 Information on this scheme is derived from private communications and the article by Messrs. Morel and Mercy in *Machinisme Agricole Tropical*, which has already been cited.
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One of the virtues of the scheme has been that it avoided making mechanization too easy for the farmers and has apparently made them work harder. This advantage could easily be sacrificed with rapid mechanization. Such a danger would be all the more acute if participating farmers were not required to pay all of the costs. That this might happen is indicated by the fact that even in 1964 one-third of the farmers defaulted on their payments, apparently not because they could not pay but because they thought payment would not be enforced.

Mechanization on settlement and irrigation schemes

Mechanization has most often been tried on settlement and irrigation schemes where conditions are in principle more favorable to the employment of machinery than those on scattered small holdings. However, the postwar history of tropical Africa records many failures including, to mention only a few, the well-publicized groundnuts scheme of the Overseas Food Corporation in Tanzania; a somewhat similar scheme undertaken by the Compagnie générale des oléagineux tropicaux in the Casamance area of Senegal; the Niger (Mokwa) Agricultural Project in Nigeria; and the Damonga (Gonja) Resettlement Scheme in Ghana. The reasons for failure were often many and complex, but usually they included one or more of the following: low value of crop per unit of area in relation to costs, which in turn may have been attributable to the low production potential of the land; high cost of land clearance; inadequate attention to land and settler selection; failure to heed bottlenecks which could not be overcome by mechanization; and excessive costs of mechanization owing to high overheads, heavy repairs, and poor choice and inadequate utilization of machinery. It is possible that some, though by no means all, of these difficulties could have been overcome in the light of the experience that has since been gained.

Mechanization has been on the whole more successful on irrigation schemes, largely because irrigation usually makes it possible to achieve a high output per unit of area and the control over water supply sometimes permits a staggering of cultivation operations over a considerable period. In fact, the use of machinery on irrigated areas may be the only way of securing the proper scheduling of agricultural operations which is required to achieve good yields. The Gezira irrigation scheme in the Sudan is probably the most outstanding example of a successful mechanized scheme which has yielded good returns to the Government as well as to the participating tenant farmers. Among the reasons for its success has been the ability to spread the more important mechanical operations
over the dry season, the high value of long-staple cotton output per acre, and the access to a large reservoir of migrant labor for the performance of such tasks as weeding and picking which could not be mechanized. In Kenya, the Mwea-Tebere irrigation scheme, where about 5,000 acres of rice land are mechanically prepared by rotavator, has also proved to be a success. Here mechanization has made it possible to achieve much better land preparation and scheduling of agricultural operations; and it has not proved necessary to mechanize other operations because sufficient labor is available for transplanting and harvesting the rice. The high yield—an average of 2.35 tons of paddy per acre in 1963—has been more than sufficient to support the costs of mechanization and other inputs and still leave the farmer a handsome return. Another irrigation scheme in Kenya—Perkerra—has been much less successful, although it probably has demonstrated that tractors can be economically used for the cultivation and spraying of onions which after many years of trial and error have proved to be a profitable crop.\textsuperscript{60}

Mechanized irrigation schemes have by no means been universally successful. The Richard-Toll irrigation scheme in Senegal, where around 5,500 hectares (13,585 acres) are devoted to the mechanized production of rice, has apparently never proved profitable. There, all operations ranging from land preparation to harvesting and threshing are mechanized. Despite the use of fertilizers and herbicides the average yields obtained, ranging from 2.48 to 3.27 tons per hectare (1.00 to 1.32 tons per acre), have been disappointing and insufficient considering the high investment cost per hectare and the recurring costs of mechanization.\textsuperscript{61} In the Office du Niger in Mali, a similar attempt with completely mechanized production of rice failed after some years. In the same area mechanized preparation of rice land for tenant farmers was largely abandoned. However, continued labor shortages and the loss of tenant farmers have been instrumental in impelling the management to assume direct responsibility for farming of considerable rice land and to use machinery to cultivate and sow such land. Tractors are also employed for ridging virtually all cotton land, and this practice may well be the only means of obtaining timely planting of cotton under the prevailing conditions. On the whole, the economics of mechanization in the Office du Niger is extremely difficult to appraise in view of the lack of reliable data on costs and the unfavorable effect on

\textsuperscript{60} See our study, "Observations on Some Irrigation Schemes," in Vol. 2.

\textsuperscript{61} A thorough recent appraisal of the scheme does not seem to have been made. Some useful information is contained in a paper by M. Couey entitled "La riziculture mecanisée à Richard-Toll," \textit{CCTA Symposium on Rice}, Conakry, 1963.
yields of other factors such as deficiencies in irrigation and drainage.\textsuperscript{62}

**Mechanized state farming**

Mechanization has been a prominent feature of state and cooperative farming enterprises which have been undertaken on a considerable scale in a number of countries. Such ventures have generally been launched for the purpose of "modernizing" agriculture, an objective which its advocates generally consider to be virtually synonymous with mechanization. In Ghana, particularly, substantial personnel and material resources have been devoted to the establishment and operation of such farms, beginning in the year 1962. By the end of 1964 three organizations—the State Farms Corporation, the Agricultural Wing of the Workers' Brigade and United Ghana Farmers' Cooperative Council—had apparently acquired around 465,000 acres of land of which 145,000 had been cleared and 64,000 put under cultivation. Large sums have been invested in mechanical equipment both for clearing and for cultivation. Experience, while not permitting a definite judgment in all respects, has shown how difficult it is to make such schemes successful. We have already mentioned the heavy clearance costs which were incurred. The productivity of the state farms, whether expressed in terms of land or labor employed, has generally been very low and evidently far from sufficient to meet the annual operating costs, including those for machinery and labor, quite apart from any return on development costs. It is undoubtedly difficult to determine how far the high costs and low yields are due to mechanization as distinguished from government operation and management. In this case at least, the two appear to be inseparably linked. Experience elsewhere would, however, support the hypothesis that even without taking into account any inefficiency traceable to state management it would be difficult, in the savannah areas where these state farm ventures have for the most part been established, to increase outputs sufficiently to meet the costs of mechanization.

**Concluding remarks**

Past experience hardly makes it possible to prescribe exactly under what conditions mechanization is likely to prove economic. The many factors affecting costs and output and their relationship vary too much. No doubt mechanization can play a role in breaking

bottlenecks in agriculture, but experience does indicate that the conditions essential to its successful introduction are by no means easy to meet. In most cases prudence dictates that mechanization be tried on a pilot scale in order to determine whether the requisite conditions for success exist and whether people will take advantage of mechanization by working and producing more rather than less. This will avoid serious waste of resources and provide the time to develop the managerial and technical skills that will be needed for operations on a progressively larger scale. The more recent ventures with mechanization in Tanzania and Ghana have again demonstrated the possibility of substantial misapplication of resources when a more cautious approach is discarded. It is extremely risky to devote a large proportion of scarce material and personnel resources in efforts to mechanize a small fraction of the country's farm land when it is not sure that these efforts will really result in an increase in net output.

One is impressed by the diversity of experiences with animal-drawn and tractor-drawn implements in tropical Africa and by the fact that no comprehensive effort is apparently being made to analyze these experiences and make the conclusions of this analysis available to all the countries of tropical Africa. The chronic tendency to repeat mistakes will remain as long as there is no proper and easily accessible record and analysis of past experience. The urgency of improving and increasing the equipment of African agriculture cannot be denied. Unfortunately, all the experience of the past has provided warnings of difficulties, but few concrete guidelines for a more positive approach. In many cases, for instance, it is difficult to determine whether mechanization has failed because it was inherently uneconomic, or because it suffered from certain technical and managerial problems that could have been avoided or overcome.

There appears to be a need for an international center, whether within ECA or FAO, which would be specially concerned with the problem of agricultural equipment in Africa. Such a center should serve to collect, analyze and disseminate all relevant information on experiences with various types of traction and equipment under different conditions. On the basis of continuing evaluations of such experiences it would recommend and sponsor further experimental and developmental work to devise improved types of implements and machinery. The center should not discourage countries from trying various forms of mechanization and animal traction, but seek to assist them from the very beginning in keeping records that are sufficiently detailed and uniform to permit adequate evaluation and comparison. In the past records have been kept so poorly that
It has been extremely difficult to determine the relevance of experience in one area for the problems of another. Costly and avoidable mistakes have been made again and again. Thus the center should strive to get international agreement on the types of records that should be kept—e.g., the climatic, soil and farming conditions under which machinery is used; the number of hours during which machinery is operated and which are needed for various tasks; the time and expenditures required for repairs, etc. The center should also assist in providing such personnel as are required to keep records of this type.

Such a center would have at least two important advantages. First, it would be able to determine under what conditions and within what limits existing types of machinery and equipment found useful in certain areas and under certain farming conditions could also be effectively and economically employed elsewhere. Secondly, it would promote and coordinate, in close cooperation with departments of agriculture, manufacturers and farmers, work on the development of types of equipment that would be better suited to the various conditions prevailing in tropical Africa. The emphasis would then no longer be primarily on attempts to adapt the pattern of African agriculture to the requirements of existing machinery, but rather on efforts to devise implements and equipment that would meet the needs of the types of farms and kinds of farming obtaining in Africa. To be sure, development work of this character has been and is being done in a number of places, but it is on too small a scale, is often inspired too exclusively by engineering considerations, and the results are not adequately disseminated. The entire problem of machinery and implements in African agriculture is too important and too difficult to be left to uncoordinated, haphazard and wasteful experimentation and development.
In the preceding chapter we referred to certain changes in land tenure which have been made to facilitate mechanization. These reflect the constant search to adapt "land holding" to the evolving social structure and technical and economic requirements. What adaptations or changes are necessary and how these can be effectively brought about are objects of constant controversy. Underlying this controversy are differences in social and political philosophy as well as variations in the emphasis put on security, on the one hand, or on maximizing output, on the other hand. Some have long believed that only unchallenged individual ownership and the ability to buy and sell land will provide the best incentive to development and increase the chances that land will be efficiently farmed by those possessed of the most energy, initiative and skill. Others fear that individual ownership will lead to excessive inequalities in land and income and produce a landless class contrary to African tradition which would ensure everyone some stake in land as a fundamental birthright. Still others would reverse the trend toward "individualization" of land tenure that has long been evident and bring land under state and cooperative management which in their view would not only eliminate the "excesses" of individualism but provide a short-cut to the modernization of agriculture.

Except in some rather limited areas, the land tenure problem in tropical Africa has not arisen out of concentration of land ownership in the hands of the few and the relationships of landlords to tenant cultivators. Instead, the problem has been one of defining rights to land and of determining the relative emphasis put on individual rights as against group or communal rights under changing sociological, economic and technological conditions.

The need for a more precise definition of land tenure and a resolution of possible conflicts between individual and group rights has only gradually become important. There was no great demand for a more exact determination of land rights as long as there was plenty
of land for all and everyone could get enough of whatever land that was needed for cultivation without sacrificing the customary practice of bush fallowing to replenish soil fertility. It was only as land became scarcer, as markets developed, as new crops and methods of cultivation were introduced and as human wants changed that interest in a more permanent type of farming arose and nuclear families and individuals accordingly asserted a progressively more definitive claim to a particular piece of land within the area occupied by their lineage, clan or tribe. It may be argued that this claim is not a property right but a right of usufruct, but today farmers over most of Africa would in fact be very much surprised if they were told that the land they till regularly and pass along to their descendants does not belong to them. In fact in some areas (Bugisu District in Uganda, for example) the pioneer cultivators of new land long ago established what amounts to absolute rights over the land. (These absolute rights did eventually become subject to some control, with respect to the transfer of land to “outsiders,” by the minimal lineage groups of the pioneers’ descendants.) The desire for secure and individual possession of land that today seems to be especially associated with progressively increasing population pressure and cash cropping tends to conflict over much of Africa with the deep-seated belief that land should be “shared”; that no matter how long a man has been away from his native locality, or how long he has ceased to farm, he should at all times be able to return to his home area and rightfully claim the use of a piece of land from his chief or kinship group. This right of access to land is obviously critically important in a society where land has traditionally been regarded as the most reliable and enduring source of wealth and income and where urban and industrial centers have as yet been unable to provide alternative job and old age security. The conflicts arising out of these two concerns not only create a land tenure problem, but also give rise to resistance to attempts to deal with the problem.

African systems of land tenure have shown considerable flexibility and capacity to evolve with changing requirements and circumstances. For example, the extent to which rights in land have become “individualized” has varied greatly in accordance with conditions. Over most of tropical Africa individual families may be said to possess their own land, together with the right to transmit it to successive generations, at least as long as they use it. Usually, however, the right to continuous usufruct extends only to cultivation. Grazing on uncultivated land and on stubble for the most part remains a communal right, although here and there grazing land has also been the object of spontaneous enclosure or appropriation. The sale
of land is not a general practice in tropical Africa, but it has developed in areas where land is very scarce or is being increasingly utilized for commercial farming, particularly for the cultivation of tree crops. In a number of cases peoples desiring land for tree crops such as cocoa have found the means of acquiring it by purchase or rent in areas controlled by other tribal groups but only sparsely inhabited. The initiative for such land acquisition has come both from individuals and from groups formed on the basis of kinship or residential ties. Even when land has been purchased unconditionally, this does not necessarily mean, however, that the purchaser and his heirs subsequently have an unqualified right to sell or otherwise alienate it. The right to sell land acquired under these and other conditions is often subject to various qualifications which themselves may change or disappear in time. It may extend only to that portion of the holding devoted to tree crops or to the tree crops themselves rather than to the land; and the alienation of land to others may be subject to the approval of the traditional authorities of the lineage, clan or area in order to prevent "strangers" from acquiring land. Customary law normally prescribes who may inherit land rights, but it, too, may change in accordance with circumstances. Thus in some areas where matrilineal succession used to

1 Polly Hill has shown how certain peoples from the southeastern coastal plains of Ghana purchased land for cocoa planting in the forest areas to the west-northwest. Purchase was made primarily by groups formed specially for this purpose—kinship groups in the case of matrilineal societies and "residential" groups in the case of patrilineal societies; and the land once purchased was allocated among the members of the group for farming. The peoples who employed this method of land purchase did not have land of their own suitable for cocoa, but they were anxious to "buy" opportunities to grow it since their appetite for cash income had been whetted by production and sale of palm produce. In some of the Nigerian cocoa-growing areas, on the other hand, the progressive occupation of good cocoa land produced a drive to obtain new land in "alien" areas. Thus Galletti, Baldwin and Dina pointed out in their study of Nigerian cocoa farmers that "the intending planter of cocoa now very often has to go somewhere where he is a stranger to find the land he needs. He is willing to pay for the privilege of making a profitable investment and the groups 'owning' the land he requires are able to secure payments which, whatever they are called, are equivalent to purchase prices and annual rents. The old systems of land rights are therefore being modified into forms more suited to a commercial agriculture but less likely to maintain unimpaired the communal, lineage or 'family' estate." See Polly Hill, The Migrant Cocoa Farmers of Southern Ghana and Galletti, Baldwin and Dina, Nigerian Cocoa Farmers, Chapter VI.

2 As a matter of fact, Polly Hill has pointed out that in the cases she has examined, the land purchase tends to be converted from individual property to lineage property in the sense that its alienation and its inheritance must conform to the customs of the lineage (ibid., particularly p. 127). It is conceivable, however, that such limitations on its disposal might disappear again if and when land becomes increasingly scarce and coveted.
Land Tenure and Land Use

be the rule (e.g. the Ivory Coast) the development of coffee and cocoa planting eventually created successful pressures for a change to patrilineal succession which would allow parents to pass the fruits of their labor to their own sons. However, in other areas (e.g. Southern Ghana) matrilineal descent has evolved in a way that apparently has made it quite compatible with development.³

While land tenure has been considerably modified and adjusted to changing requirements through a process of natural and spontaneous evolution, it should not be assumed that there is no occasion for government intervention. True, land questions are so basic to people’s livelihood that government attempts to deal with them often encounter deep-seated suspicions. Irreparable damage may be done by ill-considered and ill-timed measures. However, the issue is not so much whether the Government should intervene, but when and how it should intervene. It cannot expect to reform or change land tenure patterns before the people affected themselves appreciate in large measure the necessity for some sort of intervention. At the same time, it may be seriously remiss in its responsibilities unless it awakens people to emerging needs and helps them to adjust to these before it is too late to take remedial action.

In this chapter we shall make no attempt to deal with the whole complex subject of land tenure in its numerous forms and manifestations. We shall confine ourselves to a consideration of some of the ways in which governments have found it advisable to intervene for the purpose of promoting and regulating individual tenure, of rationalizing customary methods of land allocation and tenure, or of bringing about collective or communal methods of holding and utilizing the land. In each case an attempt will be made to describe briefly the measures taken, to indicate their effectiveness in the given situation and to consider under what conditions they might be more generally applicable.

Efforts to improve and promote individual tenure

Three cases of government intervention to encourage and regulate individual tenure will be examined here. These all took place since

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³ In the previously cited study, *Migrant Cocoa Farmers of Southern Ghana*, Polly Hill argues that the matrilineal societies she has studied have experienced no incompatibility between matrilineal succession and development. Her study does indicate, however, that this compatibility has been promoted, if not ensured, by practices whereby (1) men forming kinship groups to acquire land for cocoa growing get their wives’ brothers to participate in the purchase, thereby securing for their own children an eventual share of the land, and (2) children of brothers and sisters enter into “cross-cousin marriages,” thus establishing an identity of interest in the land.
the last war and include (1) the campaign in Kenya to consolidate, register and issue legal titles to individual land holdings, (2) the measures taken in Southern Rhodesia (now Rhodesia) to issue permanent cultivation and grazing rights to Africans in the so-called reserves, and (3) the village land reorganization schemes attempted in Nyasaland (now Malawi).

In Kenya

In Kenya this type of government intervention has been most far-reaching. It has ensured landholders not simply secure utilization rights, but freehold title so that they can pledge their land for loans and transfer their land not only by inheritances but also by sale, albeit with certain restrictions. It has extended not only to arable land but also, save in some instances, to grazing land. Wherever landholdings had become badly fragmented, the object was to consolidate it in a single holding prior to registration. Where fragmentation was not a problem, the aim was to confirm and occasionally to rationalize individual appropriation or enclosure of land that had already taken place. There was never any intention to change the amount of land held by any family, but only to consolidate it and to fix its boundaries so that these would no longer be subject to litigation.

Although reliable figures are difficult to obtain, about 1.5 million acres had reportedly been registered by mid-1965, and an equivalent area had been demarcated prior to registration. This total of 3 million acres, which apparently excludes land that has been consolidated and enclosed without the intervention of the government, probably accounts for a little over a fifth of all the reasonably good agricultural land in African hands in Kenya. The comparatively small area covered has been due in large part to the emphasis placed on the need to proceed only with the concurrence of the vast majority of the population. The most rapid progress was made in the Central Province during the early years when the Emergency occasioned by the Mau Mau rebellion was in force, because elements that would have been likely to oppose were in detention and the resettlement of people in villages as a measure of security greatly facilitated the land exchanges essential to consolidation. After the Emergency, consolidation and registration went much more slowly. To get the consent and cooperation of the people often proved to be a painfully slow task, particularly since, before independence, it was rather easy to whip up distrust of the attempts of a "colonial" government to intervene in land matters that were so basic to every African's sense of security. Today, however, the demand for action
in this field has outrun the Government's capacity to meet it because the advent of independence has reduced the distrust of government and people have become increasingly aware of the benefits that consolidation and registration have actually brought to certain areas. There now seems to be a need to determine more clearly the conditions under which these changes in land tenure would actually make a significant contribution to the further development of agriculture and animal husbandry.

The procedure followed in the consolidation and registration of land in Kenya has been set forth elsewhere and does not need to be detailed here. The work was done as simply as possible, thus avoiding needless refinements and striving after perfection. The Government's role was kept to an absolute minimum. Committees of landholders representing, above all, the men who under customary law were competent in land questions were given broad authority. Subject to certain rights of appeal, it was they who settled disputes about existing land rights, decided on consolidation and determined the siting and boundaries of the holding to be registered. Individual landholders were responsible for marking the agreed boundaries with hedges or by other means so that they could show up on the aerial photographs from which maps recording each holding were eventually drawn for the land register. The Government had the task of providing "surveyors" who used simple methods to measure the land, of being the ultimate arbiter in disputes, of furnishing the necessary maps, and of preparing the final land register and issuing the necessary titles. The Government, too, was instrumental in ensuring that adequate land was set aside for public purposes, including roads, schools, etc., and for carrying out such soil conservation work as was considered necessary to protect the land. Under these conditions it has been possible to do the work very cheaply, at a cost which on the average has apparently not exceeded £1 to £2 (£2.80 to $5.60) per acre.

There is general agreement in Kenya that this type of land reform has been very beneficial. Where land disputes were causing costly litigation and a sense of insecurity, the registration of land has saved expenses and given the people the security essential to development. Where land was badly fragmented, consolidation has conserved both labor and land and made possible more effective utilization of these two factors of production. Consolidation and enclosure have been virtually indispensable to the profitable development of dairying in the higher areas of Kenya and have generally improved the incen-

* See the Preface to the case studies of Kenya in Vol. 2.
tives for the development of commercial agriculture. However, all this does not mean, as we shall point out later, that such benefits have accrued or would accrue under all conditions.

In Rhodesia

In (Southern) Rhodesia the land tenure changes were carried out under the Native Land Husbandry Act of 1951 which was designed, in accordance with its preamble, "... to provide for the control of the utilization and allocation of land by the natives and to ensure its efficient use for agricultural purposes. ..." In many respects this legislation approached land tenure in ways quite different from those in Kenya.

First, a clear distinction was made between arable land and grazing land. The Act provided for the grant of both cultivation rights and grazing rights, but whereas the former created the right to cultivate a defined piece of land, the latter was a right to graze a specific number of livestock on a communal grazing area.

Second, title was not given to land and land could not be pledged as security for a loan, although both cultivation and grazing rights were transferable by inheritance and sale subject to certain conditions including a prohibition against fragmentation.

Third, it was, in principle, more of an attempt to reallocate land than to make a final determination of existing rights to land and to consolidate such land within the framework of these rights. It was the aim of the Act to give people as far as possible enough land for cropping and grazing so that they could earn a reasonable livelihood as full-time farmers. Others, it was hoped, would become full-time laborers, thus curtailing the usual type of labor migrant who seemed incapable of developing either into a skilled laborer or a competent, commercially-minded farmer. Each rightholder, for example, was to be assured a "standard" arable holding that would suffice, together with the grazing right, to provide an adequate income from farming alone. The size of the "standard" unit was determined primarily by ecological conditions but was adjusted to some extent to family status, i.e., whether the rightholder was a monogamous or polygamous household, a widow or widower, etc. In actual practice, the supply of land in many areas proved so inadequate in relation to the number of people to be accommodated, that far-reaching adjustments in the allocation formula were necessary. In most cases, the allocation apparently had to be cut well below the "standard" that was supposed to be the economic minimum; and in the most crowded areas, which were usually identical with those ecologically most favored, it was not possible to do more than to
recognize the prevailing distribution of cultivated land and to re-site, where necessary, the amount of land that each rightholder had been accustomed to cultivate.

Fourth, the scope of the Act was much more sweeping. The intention was to apply the Act as rapidly as possible to all of the approximately 34 million acres reserved for the use of Africans. This meant that less attention could be paid to variations in conditions or to the necessarily time-consuming task of getting the participation and cooperation of the people concerned.

Finally, the Act associated changes in land tenure with a requirement that rightholders abide by specified practices and rules of good husbandry which were enforced by fines and, upon a third violation, by compulsory sale of cultivation or grazing rights.

Although we had no opportunity to make a first-hand study, the analyses made by others clearly indicate that the Native Land Husbandry Act was much less successful than land tenure reform in Kenya. Implementation of the land tenure provisions of the Act was undoubtedly accompanied by certain desirable physical improvements such as soil conservation works, roads, waterholes, dams and bridges. Yet the implementation of the Act savored too much of compulsion. Its application was often rather arbitrary and apparently did not give adequate recognition to the rights of absentees. Not only was the land tenure reform imposed and carried out with little participation by the people concerned, but it was associated with the enforcement of regulations such as destocking which, however well-motivated, were exceedingly unpopular. The primary concern was with the preservation of national resources, which was undoubtedly of long-term value but which comparatively ignored the more immediate task of increasing output in which the African had a more direct stake. While efforts were made to provide more extension services and credit, these were rather disproportionate to the large area involved. There was a dearth of tried and tested plans for developing remunerative, commercial farming on the new holdings. The allocation of all land and particularly the division of land into arable and grazing land, proved far too inflexible and severely limited the African farmer's traditional practice of taking new land under cultivation. Based on technical land capability criteria, this

\[ \textsuperscript{5} \] See B. N. Floyd, Changing Patterns of African Land Use in Southern Rhodesia (Lusaka, Rhodes-Livingstone Institute, 1959).

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classification did not take into account the possibility that such grazing land might well, under conditions of increasing population pressure, yield far more if it were converted into cultivated land in accordance with the customary African practice of taking fresh land under cultivation at the expense of natural pasture. All in all the rather far-reaching interference in traditional land tenure and practices and the lack of any marked immediate benefits made the Native Land Husbandry Act increasingly unpopular. In fact, its unpopularity brought about the virtual suspension of its further application by the end of 1962 when the grant of rights had covered less than 50 percent of the arable and 40 percent of the grazing area.6

In Malawi

In the former Nyasaland attempts to change the pattern of landholding proved a complete failure, apparently for reasons rather similar to those which prevented success in Rhodesia. In Nyasaland the Department of Agriculture devised an integrated program of land consolidation and technical improvements in land use to deal with the consequences of aggravating population pressure on land—subdivision and fragmentation, mono-cropping of maize, and high labor migration. Embodied in so-called Village Reorganization Schemes, these measures had been extended to 38 areas by 1958/1959, and encompassed some 200,000 acres. During the next few years, however, all these schemes were abandoned and the situation reverted completely to the status quo ante. Judging from conversations with those concerned in carrying out these changes, the reasons for collapse of the effort were many and their relative importance is difficult to evaluate. The political opposition to the land reform measures, which were tarred with the "colonialist brush," undoubtedly triggered their abandonment. It seems unlikely that this would have prevailed so completely, however, if the benefits of the land consolidation had become clearly apparent to the farmers. Inadequate efforts were made to explain the program patiently to the people from the beginning and to prepare them to accept it. It appears to have been assumed, often erroneously, that the consent of the chief of the area was enough and that he could and would enlist the genuine support and participation of the headmen and the people. There seem to have been particular problems in winning over the women who, in the matrilineal society prevailing in the

6 Percentages were higher in terms of the total number of people and livestock. Thus about 80 percent of people with land right claims were reported to have been given farming or cultivation rights, and over half of the grazing rights had been registered. See Makings, *Problems in African Agricultural Development*, p. 84.
affected areas, were of critical importance in any land reform and who were sometimes needlessly alienated by the way in which land redistribution was carried out. Perhaps most important was the lack of any immediate striking benefits. This was partly due to the fact that consolidation, unlike the consolidation in the Central Province of Kenya, did not open up, or was not associated with, opportunities to adopt remunerative cash crops or new forms of animal husbandry. As a matter of fact, the new system of land use which the Department of Agriculture sought to introduce into each consolidated area apparently often had the effect of reducing both production in the short run and the areas available for grazing. In its technically oriented preoccupation with the long-term need for restoring soil fertility, the Department insisted on a rotation with more fallow, thus reducing the cropped area. While the Department was simultaneously propagating a number of practices designed to raise yields such as pre-rain hoeing, ridging, and adherence to weeding schedules, these practices proved very difficult to apply, especially in areas where the high rate of labor migration had reduced the supply of able-bodied adults. The failure of the Village Reorganization Schemes in Nyasaland does not, of course, indicate that the government of that time was necessarily wrong in its belief that a fairly drastic reorganization of the land tenure system was essential to agricultural development. With changes in the political environment and some alterations in the methods of tackling the program, land reform might be successfully carried out. In fact, since independence there is reported to have been a growing demand for consolidation and an increasing amount of informal exchange and consolidation of fragments.

Conditions of success

The experiences briefly described and analyzed above demonstrate the importance of determining when, under what circumstances, and how to intervene for the purpose of improving and securing individual land tenure. Some of the conditions that merit intervention and that are essential to its success may be set forth as follows:

1. The farmers potentially involved must have a genuine desire to develop their land. Security of individual land tenure, whether it takes the form of a legal title to land or falls somewhat short of this, is not by itself a sufficient incentive for land development. Sometimes land is enclosed and permanently appropriated only in order to keep others from claiming and developing it. Thus the reported desire for enclosure and registration on the part of the pastoral Masai, who occupy a large area of excellent agricultural land in Kenya but who
do not seem to take readily to agriculture, may be motivated mainly by a concern to protect their land against encroachment by larger and more active neighboring groups. The granting of land titles under conditions which are unlikely to be followed by actual development of land probably introduces an undesirable measure of inflexibility. It may protect the holder in his failure to develop land rather than stimulate him to do something constructive with it, and therefore may actually be disadvantageous compared to the traditional tenure which insists that rights to land are contingent on continued use. Even among the Kikuyu of the Central Province of Kenya, where land registration was carried out and where many people are eager for development, we noted considerable areas which have been left idle or virtually idle. A number of Government officials and politicians were accordingly beginning to think of the possibility of imposing a land tax which might at least penalize to some extent the failure to develop land following the granting of titles.

2. There must be potential for profitable commercial farming of the land and the government must be capable of assisting farmers effectively in realizing this potential. In Kenya land consolidation and registration were most successful in the areas of high agricultural potential such as the higher areas of Central Province, including Embu and Meru. Even before land tenure reform the development of lucrative commercial crops, particularly coffee, had already demonstrated the potential value of the land; and land consolidation, enclosure and registration gave a further fillip to the expansion of such crops and created the conditions for the introduction of profitable dairying. On the other hand, the more modest possibilities in much of Central Nyanza District made any drastic change in land tenure much less attractive and less necessary. The Government must follow land tenure reform closely with adequate extension, credit and marketing facilities. There must not only be a reasonably well-trained and well-staffed extension service but it must have ready tested and remunerative plans for the development of individual holdings. As already noted, the inability on the part of the Government to help the farmer realize immediate benefits was one of the important factors responsible for popular antagonism to the changes in land tenure attempted in Rhodesia and Malawi. By comparison the Government of Kenya was much better prepared to follow up, although even there shortcomings were evident. In 1964 we saw a striking demonstration of the need for prompt follow-up in the Fort Hall District of Kenya. There it was evident that consolidation had in most cases brought about an expansion of the area under crops and that the
more extensive cropping of the rather steep hillsides of this populous district was producing a serious erosion danger. Thus it was apparent that farmers needed prompt help in planning the use of their consolidated holdings in a way that would obviate the danger of erosion.

3. Measures designed to introduce permanent individual land tenure and consolidation can be carried out only with the voluntary participation of the people concerned and are therefore bound to be slow. People can generally not be compelled to accept changes affecting their rights to land, for land is at the heart of the African’s security and many of his traditional practices and customs. The experience in Rhodesia and Nyasaland shows that paternalism and compulsion produce opposition rather than acceptance. In carrying out land tenure changes maximum reliance must be placed on popular participation. As much of the work as possible needs to be delegated to committees who represent the farmers and are conversant with customary land law and land rights. However, it is not necessary to wait until one hundred percent approval of all the parties concerned is obtained. It is sufficient, as has been the practice in Kenya, that a substantial majority fully understand the implications of proposed changes in land tenure and are ready to accept them.

4. Increasing and costly litigation about land is often a clear sign that government intervention to settle claims and establish permanent security of tenure is necessary. Land disputes multiply rapidly when good land becomes progressively scarcer. There may be arguments about boundaries between clans and between individuals, and rival claims to the same piece of land. While there are traditional ways of settling these disputes, the “settlement” effected in this way usually applies only to the parties to the dispute and does not prevent the raising of new claims by others. The very fact that the members of any small or larger kinship group feel that they have a claim to a share in land no matter how long they may have been away gives rise to the constant emergence of new claims. When disputes become more numerous, experience also shows that there is a sharp increase in the danger of bribery and favoritism by the authorities traditionally called upon to settle them. The record in Kenya demonstrates that the termination of costly and endless litigation was a strong motive for, and a considerable benefit of, the Government measures taken to delimit and register individual landholdings.

5. Another justification for government intervention may be the need to deal with fragmentation and subdivision which, like land litigation, tend to become more acute with land scarcity. However, the simple fact that a single holder may have a number of land parcels is not necessarily a subject for concern. In West Africa where the village pattern of settlement
obtains and land is not scarce, each farmer may have three different parcels of land—one around his house, another adjoining the village and still another "in the bush." He may also have a piece of bottom land which is used for growing a particular crop such as rice. In parts of West Africa, too, one may encounter a farmer with several plantings of cocoa or robusta coffee which may be separated from each other solely because he has at various times cleared different patches of bush for these tree crops. Such types of fragmentation do not in many cases interfere seriously with farming. Intervention through consolidation will generally be necessary only when fragmentation through successive subdivision of land among heirs becomes such as to make rational use of land impossible at the very time when population pressure dictates the need for greater intensification and optimum land use. Under such conditions the distance between fragments may detract from vital labor inputs or cause neglect and even abandonment of the smaller, more distant holdings. It becomes difficult to look after scattered small fragments or to plan their use effectively. The possibilities of introducing mixed farming or improvements in livestock husbandry may be completely vitiated. Moreover, as the experience of the Central Province in Kenya shows, the multiplicity of ditches and paths bounding or providing access to scattered fields can promote serious erosion. Consolidation under such conditions can be done through self-help efforts but it cannot be carried out rapidly, comprehensively or very efficiently unless the government steps in and provides an orderly procedure for accomplishing it and the necessary assistance in surveying land and recording the results of consolidation. However, consolidation should not under all conditions aim to bring all of the land of a farmer into a single holding. Where soils are not homogeneous and fragmentation is caused by ecological factors, consolidation which does not respect the farmer’s need to retain different types of land may encounter adamant opposition.

6. Still another reason for government intervention may be the necessity for dealing with a progressively more intractable livestock problem. In areas

7 We do not mean to suggest, however, that there are no areas in West Africa where population pressure on land has not produced fragmentation and litigation that call for land consolidation and registration. This might be true, for example, of some of the densely populated parts of Northern and Eastern Nigeria. It must also be admitted that the scattering of different parcels through successive clearing of land does produce problems even though each farmer may in the aggregate have plenty of land. The distance between various parcels may lead to the establishment of special "camps" in the bush, which operate as base points for farming new holdings, or, in many cases, to new patterns of settlement with farmers moving to, and organizing their principal farming activities around, that part of their land that has proved to be most productive.
where there is a strong livestock tradition, the custom of common or free grazing is often so deep-rooted that it persists long after increasing pressure of population and livestock on the land makes the problem of maintaining livestock without continuous degradation of pasture land exceedingly difficult. As long as it is impossible to enclose land, it is almost equally impossible to improve grazing, grow fodder, limit the number of cattle to available supplies of feed, and combat tick-borne diseases by spraying or dipping. Enclosure, and in many cases consolidation, were prerequisites of the rapid spread of modern dairying which in the last decade has given such a fillip to the development of Kenya’s higher areas. This does not mean, of course, that enclosure can under all conditions contribute to the solution of overgrazing and poor livestock management. In poor and dry grazing areas unsuitable for agriculture, enclosure or the establishment of individual ranches may well be impracticable either because there is not enough land to meet the need or because the cost of developing such individual ranges and particularly of investment in water supply and, possibly, fencing is likely to be excessive. But where farm and animal husbandry are carried on together and the growing scarcity of land makes it increasingly difficult to support an adequate number of cattle in the traditional manner it does appear essential. This is probably true, for example, of some portions of Machakos and Central Nyanza Districts which we visited. In such cases, the government can intervene by fostering an awareness and understanding of the problem through its community development service, by supporting individual enclosure against the opposition of the traditionalists and, finally, by providing the machinery and means for carrying out enclosure when the majority of people want it but only a recalcitrant minority is successfully thwarting it.

7. Finally, attention must be paid to the problem of finding employment for people who as the result of consolidation and registration of land are deprived of land. In part these may be cultivators who, like the *ahoi* among the Kikuyu in Kenya, have been allowed to till some land, usually isolated fragments, without, however, having a right to land under prevailing customary law. Often these are denied further use of land after consolidation. To a much larger extent, however, it is a question of people who in the future will no longer be able to exercise a traditional claim to some share in the land. These include, above all, heirs who in the interest of keeping the holding intact and avoiding the consequences of renewed subdivision are no longer entitled to inherit land. Unless people thus made landless can find wage employment in agriculture, commerce, industry, and government or are given opportunities to get farms elsewhere, there will be serious
unemployment and great pressure to subdivide the land once more in defiance of legal prohibitions and to the detriment of its productivity. In the crowded Kikuyu areas of Kenya where consolidation and registration have been carried out, there is indeed evidence that renewed subdivision and sharing of land is again taking place to some extent. At the same time it is encouraging to note that the development of agriculture which has been stimulated, though not caused, by land consolidation and registration in Kenya has provided opportunities for the employment of a considerable number of permanent and casual wage laborers.\(^8\) Undoubtedly even more employment would have been engendered if a larger percentage of the land were in the hands of enterprising farmers. In theory one of the advantages of legal property rights in land is that it facilitates transfer by sale and enables the more capable farmers to acquire additional land. In actual fact, however, this advantage is not easy to achieve for a variety of reasons—reluctance to sell land for reasons of security; lack of credit facilities for the purchase of land; and government restrictions on transfers designed to prevent improvident sales or too great a concentration of land ownership.

\textit{Some conclusions}

The experience of Kenya certainly demonstrates that under the conditions indicated above substantial benefits can flow from steps to give permanent, secure rights in land and to eliminate excessive fragmentation. However, there are as yet probably not many places in Africa where one can find all of the minimum conditions essential to success. Even in Kenya it is important to avoid pushing ahead with this type of land tenure change where it may not in fact provide a significant spur to development. There is no reason to undertake it when the demand is prompted solely by the desire to freeze out other claimants to land or by the erroneous notion which we found to be quite widespread among farmers in Kenya that a title to land would automatically assure access to easy government credit for all sorts of purposes.\(^9\)

Reviewing what has been said above, we would conclude that land enclosure and registration (plus consolidation, wherever necessary) are likely to prove most useful in areas where (1) the relative density of population and ecological conditions are favorable to development and, at the same time, the opportunity to enclose land and assure

\(^8\) On this point see the case studies of Kenya, Nyeri District, in Vol. 2.

\(^9\) In this connection, the reader will have noted that we have not emphasized the importance of legal title to land as a prerequisite to a sound system of agricultural credit. We shall elaborate the reasons for this omission in the chapter devoted to credit and cooperatives.
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personal ownership tend to stimulate the inhabitants in their efforts; (2) the development of good land has been severely inhibited by fragmentation and by insecurity stemming from population pressure and the inhabitants can be convinced of the advantages of consolidation and registration. Two remarks should be added with regard to the second of these situations.

One is to emphasize again that the combination of population pressure, fragmentation and litigation is not by itself a sufficient condition. A case in point is the southern and mountainous portion of the Kigezi District in Uganda which was also included in our study. Despite a high degree of population pressure and land fragmentation, the farmers there have never shown a great interest in taking advantage of the possibility of consolidation and registration. They were never enabled to see either in their own environment or in similar environments elsewhere that profitable opportunities for tree crop development, dairying or other types of farming could be realized if holdings were consolidated. Thus they apparently saw no immediate and significant benefits that would offset the risk that they might lose valuable fragments of land in the process of land exchange essential to consolidation.

The other observation with respect to the second of the two situations mentioned above relates to the importance of timely government intervention. Population pressure on land and attendant fragmentation can easily develop to such a degree that intervention may become well-nigh impossible owing to the resistance that would be engendered and the extent to which vested interests would be disturbed. Vested interests in a particular pattern of land distribution are often strengthened by the development of certain fragments (for instance, through planting of tree crops) which people are then understandably reluctant to surrender. This happened, for instance, in the Meru District of Kenya where coffee planting on various fragments started a long time ago and land consolidation has accordingly been very difficult to effect. Another example of this is the Bugisu District on Mount Elgon in Uganda. There the planting of arabica coffee started as early as fifty years ago. While coffee production has developed significantly, it is probable that coffee husbandry would have been improved and that a considerably larger number of farmers would have planted coffee if timely measures had been taken to consolidate fragmented holdings. Such timely intervention was impossible, however, apparently because the Gisu people had a deep-seated suspicion of any government "interference" with their land rights, especially as long as this government was "colonial." Since independence it might have been possible in
theory to awaken an interest in land consolidation if influential Gisu leaders could have been persuaded to take the initiative in such a campaign, but in the last few years the incentive appears in any event to have diminished because further coffee planting has been inhibited by the International Coffee Agreement and other striking development possibilities have apparently not emerged.

Finally, we would stress that the applicability of measures to promote secure individual land tenure and the way in which such measures are carried out must be conditioned by the possibility of technical innovations and the way in which these may affect land use. Here we have in mind particularly the introduction of mechanical land cultivation and of irrigation. Sometimes it may be desirable to keep the land tenure situation fluid or undisturbed until the desirability of such innovations has been fully explored and their implications for land tenure understood. The case for experimentation with various flexible types of land tenure is discussed in the next section of this chapter. In our case study of the District of Central Nyanza in Kenya we emphasized the special situation obtaining in the Kano Plains bordering on Lake Victoria. This area still has considerable development potential and is characterized by land tenure problems, including considerable fragmentation and communal grazing, which need to be tackled. However, the type of land tenure reform can hardly be determined until the technical and economic feasibility of irrigating the plains and of mechanical cultivation of the heavy soils of the area are thoroughly examined.

**The case for flexible land tenure**

By giving people permanent rights to particular pieces of land, registration does introduce a measure of inflexibility which may make difficult or even prevent rearrangements of land that may prove desirable in the light of evolving techniques and changes in circumstances. We have already discussed two cases—one in Tanzania, the other in the Central African Republic—where such a rearrangement or regrouping of land was undertaken for the purpose of facilitating mechanized cultivation; and we have also referred to the group farming that was initiated for the same purpose in Uganda. The justification of these schemes, which involve land pooling without, however, abrogating all individual responsibility for farming, depends, in the last analysis, on the ultimate merits of mechanization. For the participants they inevitably involve not only a readiness to exchange and pool land but also some degree of discipline in farming operations; and the advantages of participation usually have to be sub-
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substantial in order to compensate for the loss of the untrammeled freedom which the farmers have in working their own land in the manner and at the times that suit them.

Group cotton farms in Central Nyanza

There have been other experiences with regrouping or reorganization of farm land which have not been prompted or were only partly prompted by a desire to take advantage of mechanized cultivation. One of these is the group farms which in recent years have developed spontaneously in the District of Central Nyanza in Kenya. Each of these represents a cooperative effort on the part of families belonging to a kinship group called the *jokokwaro*. The group farms were first started for the cultivation of sugar cane, but are now primarily devoted to cotton. In 1964, there were reported to be about 90 such group farms ranging in size from a few acres to well over 25 acres.

Land was pooled and certain operations such as plowing and dusting were usually done for the farm as a whole, with other operations left to the individual families on their parts of the group farm. The standard of cotton cultivation on these group farms was generally well above the admittedly low level obtaining on individual farms. It was characterized by earlier planting and more widespread use of manure and insecticides. Group farming appeared to have a number of advantages. Pooling of land has facilitated land preparation, whether by oxen or tractor. The group itself provided a measure of cooperative or collective discipline which helped to improve the timeliness and quality of the agricultural operations involved. The participants were apparently more willing to try on the group farm the methods of cultivation long advocated by the agricultural service because they could simultaneously hedge the risk involved by continuing traditional practices on that part of their land withheld from the pool. It is possible also that in the traditional society still largely prevailing among the Luo of Central Nyanza, new methods could be more readily adopted through group action than by individuals whose efforts to innovate may incur the envy and censure of others.

Finally, the successful application of new methods of cultivation was facilitated because the agricultural staff could provide more continuous advice and guidance when cotton was grown in rather large blocks. Whatever may be the ultimate fate of these schemes, they will probably as a minimum have proved a convincing demonstration of the benefits of certain methods of cotton cultivation which previously had largely been ignored.¹⁰

¹⁰ See the case study of Kenya, Central Nyanza District, in Vol. 2.
Some experiences with regrouping of cultivation in West Africa

We noted a somewhat similar attempt to group fields for cotton cultivation in the Sikasso region of Mali. Here the primary purpose, however, was simply to protect the crop more effectively against possible damage by livestock which were customarily left unguarded. Much more complex and comprehensive regrouping of land was being undertaken around Bouaké in the Ivory Coast as part of a general program for the improvement of agriculture. Here the idea was to organize a group of farmers, usually on the basis of kinship, who were willing to concentrate their cultivation on the area which seemed most suited to cropping. The area selected was then divided into roughly parallel bands running along the contour and separated from each other by a narrow strip left under natural vegetation to protect the land from erosion. The number of bands were designed ultimately to conform to the requirements of an improved crop rotation that would include not only the traditional food crops but also new cash crops such as cotton, tobacco, and rice. However, there was no insistence that all participants adopt the same rotation or grow the same crop in the same “band.” The principal concern was to avoid the cultivation of crops in a lot of isolated fields in the bush. The cultivation of fields in close proximity to each other did apparently have considerable appeal. It made it easier for participating farmers to protect their crops against damage by animals, to assist each other in such tasks as cotton spraying and, presumably, to learn from each other. Access to the cultivated area through a common road or track was facilitated. As was the case in Central Nyanza, it was possible to utilize to better advantage the available extension workers.

The paysannats in the Congo, Rwanda and Burundi

The regrouping of fields for cultivation discussed above represented an attempt to rationalize and introduce some order into the traditional method of shifting cultivation. This was also the basic idea underlying the efforts of the Belgians to establish so-called paysannats in the Congo, Rwanda and Burundi. Beginning in 1943, a substantial number of paysannats were organized. INEAC, the agricultural research institution in the Congo, was usually responsible for initiating them on a pilot scale and working out the crop rotations applied. Some of the paysannats were established on unoccupied land for the purpose of accommodating farmers from the more densely populated regions. Most, however, were organized in areas that were already under some form of cultivation. There the intent was not to deprive the traditional tribal authorities, usually the
village chiefs, of their responsibility for land allocation, but to get them to agree to exercise it in accordance with a pre-established plan.

This involved, first of all, selection and delimitation of the area within which the allocation of land for cultivation would be made. Usually delimitation was preceded by a soil survey so that the most suitable land would be chosen, but sometimes this was neglected in the anxiety to establish as many paysannats as possible. In the flat forest and savanna zones the normal pattern was apparently to set aside a rectangular area divided into parallel strips equal in number to the years covered by the whole rotation cycle of cropping and fallow. All the peasants participating in the paysannats were given land in the first strip opened to cultivation and then moved successively and together to clear and cultivate other strips in accordance with the rotation plan. For example, in the forest zone and part of the savanna zone the so-called "corridor" system of cultivation was adopted. This involved clearing a corridor for cultivation which was 100 meters wide, was oriented in an east-west direction to afford maximum sunlight and was bordered by bush or forest on both sides so that after a specified number of years of cropping—usually three—the strip would be quickly reclaimed by trees and bush. The method of land allocation varied considerably. Sometimes the participants received allotments only in the strips actually under cultivation, but at other times each family received a holding which extended to the fallow as well as to the cultivated strips. In some cases uniform allotments were made to all families, but in other cases this rather inflexible system was modified to take into account the varying requirements and capacities of the participating families.

This rather neat geometric pattern proved impracticable for areas where the terrain was irregular and soils were heterogeneous. Other types of paysannats were developed to meet these conditions in whole or in part. In hilly and mountainous areas cultivation on steep slopes was forbidden, the strips for rotational cropping were arranged along the contour with provision for control of soil erosion, and the holding was usually situated in such a way as to embrace some bottom land as well as land on the hillside. In another area which was rather densely populated and was characterized by marked differences in terrain, a rather elaborate land classification was worked out. Forest land was reserved, land usable only as pasture was set aside for common grazing and the arable portion was classified in accordance with its susceptibility to irrigation and its suitability for various crops. Provision was then made for allocating to participating peasants arable land in accordance with this classification.
The type of farming varied in accordance with demographic and ecological conditions. In the lightly populated areas the paysannats were generally an orderly version of the traditional extensive shifting cultivation, relying on bush or forest fallow of up to 15 years for regeneration of soil fertility. In other areas some degree of intensification involving, for example, the use of fertilizers and insecticides was introduced. While hand cultivation continued to be the general rule, mechanization was tried in some cases for land clearance and for land preparation. Crop rotations were specified for most paysannats, and, apart from the traditional subsistence crops, always made provision for cash crops such as groundnuts and cotton in the savanna regions or tree crops such as robusta coffee, oil palm or rubber in the forest zone and arabica coffee in the higher areas. Tree crops were usually planted in a continuous strip extending over a number of family holdings. Thus on the rounded hills characteristic of the highlands of Burundi and Rwanda arabica coffee was normally planted in a strip along a road encircling the hill so as to facilitate the spraying of coffee trees from the road as well as the transport of the coffee cherries to pulping stations.

The experience with these paysannats was by no means uniform. In many cases production undoubtedly increased as the result of improved crop rotation, introduction of cash crops and the availability of more professional supervision and advice. In some instances the benefits to the participants were apparently so pronounced that the paysannats survived the withdrawal of expert supervision and the disruption and vicissitudes of the initial years of Congo's independence. In Rwanda and Burundi where the paysannats primarily took the form of "orderly" settlement schemes they have remained a prominent feature of agricultural development. However, certain drawbacks also became evident. Despite the attempts to introduce various types and a degree of flexibility, some of the paysannats proved to be too schematic and rigid in their patterns of land allocation and utilization. Although the underlying principle of rationalizing and integrating traditional land use and land allocation or land tenure was sound, too little time appeared to have been devoted to persuade the peasants of the merits of the new system and to enlist their genuinely voluntary participation. The paysannats smacked somewhat of paternalism and compulsion even though it cannot be said that participation was enforced. Many farmers apparently felt that their freedom was too much curtailed by the insistence on regular rotations involving participation in annual clearing of land and the cultivation of particular cash crops and by the constant supervision to which they considered themselves to be subjected.
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Even where the *paysannats* have survived, the "cultural discipline" has relaxed and the standards of cultivation have usually deteriorated. In some cases, as we had occasion to note in the Mosso region of Burundi, farmers have definitely preferred to forego the advantages of settlement on a well-ordered *paysannat* in favor of the freer though apparently more chaotic traditional method of shifting cultivation.

**Collective farming**

As we have indicated, quite a few African leaders tend to consider individual property rights in land as alien to the African tradition that everyone should have some share in the land. They tend to believe that under modern conditions this tradition is best served by enabling the State, in place of the tribal authorities, to become the repository or custodian of the "communal" interest in land and to provide for collective or "socialist" methods of land utilization. This has given rise to ventures in cooperative and state farming in a number of countries.

**Cooperative ventures**

There have been few genuine cooperative farming enterprises. Where cooperative farming has been undertaken on some scale, as in Ghana, it seems hardly distinguishable from state farming. We have already noted instances of groups or cooperatives undertaking some farming tasks in common but under conditions that left individual family responsibility for other operations intact. In Mali, the Government has encouraged local cooperative groups to till some fields in common (so-called *champs collectifs*) not only for the purpose of earning money to finance community improvements but also in the hope that cooperative farming might find increasing favor. However, the cooperative fields have remained extremely modest and their cultivation generally does not enjoy a high priority in terms of the claims on the farmer's time. Usually the standard of cultivation is below that on the individual farms. In any event there has apparently been no disposition on the part of farmers to expand the scale of cooperative farming. In Kenya, cooperatives have in recent years bought and operated farms, but almost invariably these have been cooperatives in name only. They have not involved participation of all the members in the farming of the land, but have in essence been corporate capitalist ventures which have taken the form of a cooperative rather than a limited liability company only because of certain tax advantages. A few genuine cooperatives have
been established to operate range land acquired from Europeans, but it is too early to determine whether these will prove successful. Their fate will depend largely on the ability of the members of the cooperative to develop a collective interest in keeping the number of livestock within the carrying capacity of the range land—a condition that is likely to be fulfilled only if they come to consider livestock as a source of regular income rather than as a reserve to be tapped only in emergencies.

The group or cooperative approach to the management of range land is certainly worth trying because government-sponsored and government-directed grazing schemes have largely failed or had only limited success and because the pressure of population and livestock in a number of areas in tropical Africa has undeniably brought about serious overgrazing. The cooperative ranching ventures which we have just mentioned have been limited to former European land in Kenya. It is more urgent, however, to see what can be done with the large dry range areas that have long precariously maintained large numbers of rather unproductive animals under, in many cases, deteriorating conditions. To cope effectively with this acute problem local initiatives have to be stimulated within the framework of representative local bodies and with influential leaders playing a role in awakening their own people to the need for some sort of collective action. Thus it might be possible to persuade people at the local level to pool at least a portion of their grazing land for an experiment in cooperative management which, with technical help from the government, would envisage not simply a limitation of livestock numbers, but improvement of range land through cooperative and selective clearing and reseeding, as well as the gradual replacement of low-yielding, indigenous stock with higher-yielding, improved breeds. The possibility of keeping a portion of the grazing land and livestock outside such an experimental pool might help to overcome initial skepticism and reluctance to take risks. Such cooperative ventures would need to be carefully prepared in order to make sure that they truly respond to a felt need and that the participants are in each case confined to people who might be expected on the basis of kinship or neighborhood ties to have confidence in each other and a willingness to cooperate.

State farming

There has been more experience with state farming, but the results have not been encouraging. Attempts to launch state farms on a large scale in Guinea virtually all came to grief and were aban-
and, as we have already observed in discussing mechanization, the many ventures of this kind started in Ghana in 1962 have hardly proved promising. This is not to say that all state farm enterprises are bound to fail. Results will depend largely on the quality of management, the degree of commitment of the workers, the types of crops and the methods of cultivation employed. There may be isolated successes with certain types of plantation crops which can benefit from economies of scale and the integration of production and processing facilities such as in the case of oil palms or sugar cane. There are also crops whose production can largely be standardized so that output may not be critically dependent on the productivity of the labor employed. We noted, for instance, that the direct farming undertaken by the management of the Office du Niger in Mali had been more successful when devoted to the growing of rice rather than the cultivation of cotton. It had virtually abandoned the cultivation of cotton because yields depended too much on the care with which cotton was irrigated, thinned, weeded and picked, and the standard of performance of wage labor in these tasks simply proved unsatisfactory. On the other hand, most of the operations in rice production—land preparation, sowing and threshing—were all mechanized so that the output was not significantly determined by the efficiency of labor. In most cases collective or state farming is subject to serious weaknesses that are conducive to failure. If undertaken on a significant scale, they generally encounter shortages of managerial and technical skills which can be relieved only at the expense of efficiency. While they may find it much easier to apply new methods and new technology, their zeal for “modernization” is often undiscriminating. Excessive resort to mechanization is a case in point. Lack of sufficient cost consciousness results, as in Ghana, in excessive outlays for both investment and labor. Collective farms are usually under considerable pressure to employ more labor and to pay minimum wages which frequently exceed those that can be supported in the light of the level of productivity obtaining in the country. While plantations, including state plantations, may have certain theoretical advantages in growing certain crops, owing to the scale of operations and the possibility of ensuring better crop husbandry, such benefits are in

12 In this connection it should be pointed out that the mechanical operations were carried out for the public farm enterprises at fixed rates by another part of the State organization managing the Office du Niger. See the case study, “Mali: The Office du Niger—an Experience with Irrigated Agriculture,” in Vol. 2.
practice often more than compensated by the high cost of establishing crops and the high proportion of fixed to total operating costs. On the small individual holding where food subsistence requirements are met and most of the labor is furnished by the farm family, tree crops can usually be established at low costs and with very little support from the government; and the low level of fixed costs on such holdings sustains their ability to compete during periods of declining prices. In Nigeria the development of smallholder production of cocoa, oil palm and rubber has apparently been attended by very favorable ratios between total output and total inputs as well as between total output and Government "inputs" or assistance.\(^3\) In Kenya the phenomenal development of arabica coffee planting by smallholders during the 'fifties was financed almost entirely from the farmer's own resources; and although government credit has been available for the establishment of smallholder tea in more recent years, there is little doubt that tea planting would have made rapid progress even in the absence of government credit for plant material.\(^4\)

Finally, there is one aspect of the relative merits of individual farms and cooperative or state farms that must be particularly stressed. Under collective farming the responsibility for operations is often so diffused as to be virtually nonexistent. At best only a comparatively few learn to assume responsibility and make decisions, while the vast majority of the people employed find it a convenient way of avoiding responsibility. In the long run individually-owned and operated farms, where income is commensurate with the effort made, are likely to be more conducive to the development of the sense of responsibility, the spirit of initiative and the capacity to make decisions which are so essential to the progress of Africa.\(^5\)


\(^4\) See the case study of Kenya, Nyeri District, in Vol. 2.

\(^5\) It has been observed that family farms do develop entrepreneurship and require decisions that are "self-educating" and that collective or cooperative farms, though perhaps "responsive in the short run to the introduction of new knowledge and technology," tend to "limit the numbers of people who acquire managerial and entrepreneurial skills that, in time, they become rigid and sterile of new development potential." See Ervin J. Long, "Institutional Factors Limiting Progress in the Less Developed Countries" in Albert H. Moseman, ed., *Agricultural Sciences for the Developing Nations* (Washington, D.C., American Association for the Advancement of Science, 1964).
CHAPTER EIGHT

AGRICULTURAL EXTENSION, TRAINING AND EDUCATION

Introduction

It is axiomatic that a good extension service is essential to agricultural development. Yet it is equally true that it is useless to keep spending substantial funds on extension when the knowledge about new inputs (improved seeds and better breeds, fertilizers, insecticides, etc.) and new techniques (improvements in crop and animal husbandry, etc.) it is propagating is not such as to provide a very meaningful and attractive answer to the farmer's problems and requirements. It can by no means always be taken for granted that there are available improvements which either singly or in combination will appeal to farmers as being both profitable and feasible in the light of their sense of values and the constraints within which they must operate. We have noted in both Chad and Upper Volta that the lack of tested means of increasing output was severely limiting the accomplishments of extension efforts which in many respects were admirably organized. Likewise, in portions of Central Nyanza, Baringo and Machakos in Kenya it was evident that development was lagging because the agricultural field service did not have anything very attractive to propagate. Extension does become of vital importance once it can be effectively demonstrated that new factors and methods of production can be effectively combined to give the farmer a significant net increase in production by means that are within his command. "At this point, rapid sustained growth rests heavily on particular investments in farm people related to the new skills and new knowledge that farm people must acquire to succeed at the game of growth of agriculture."1 Under such circumstances a positive effort to get improvements accepted must be made, for "typically, farmers in traditional agriculture will not search for them."2

1 Schultz, Transforming Traditional Agriculture, p. 177.
2 Ibid.
Experiences with extension services

The extension work carried on in various parts of tropical Africa has been characterized by considerable differences in approach, scope and organization. To illustrate, some of the extension services which came within our purview may be briefly described.

In “British” Africa extension has been an integral part of the work of the “twin” Veterinary and Agriculture Departments which together have generally been the heart of the ministry concerned with agriculture and animal husbandry. Extension has thus been the “projection” into the field of these two departments, and not a separate service. Efforts have generally been made to provide at least a minimum number of field workers for each district and subdivision. Normally the principal methods of extension employed have been, on the one hand, “field day” demonstrations and meetings for groups of farmers, and, on the other hand, work with a small number of individual farmers who were prepared to follow advice and become “progressive,” “better” or “improved farmers” and whose example would then be emulated by others. The responsibility of the field service is usually confined rather strictly to agriculture and livestock. There is seldom an effort to become involved in the broader problems of rural improvement; and even in the field of agriculture there is a reluctance to accept continuing responsibilities for marketing or the supplies of requisites of production which are normally left to private trade or cooperatives.

In “French” Africa agricultural field or extension services were generally not developed to the same extent as in “British” Africa. In the absence of such well-established services or to offset the departure of French officials on the advent of independence, the governments of a number of francophonic African countries have employed Paris-based organizations in the postwar period to take charge of extension programs in specified areas on the basis of contractual arrangements. These organizations have generally been formed under the aegis and with the support of the French Government and, therefore, have a public or quasi-public character. They provide a convenient vehicle for the continued extension of French technical assistance abroad and are the means of assuring continued careers to people formerly in the French colonial service and new careers to Frenchmen who want to be active in promoting agricultural development abroad. These organizations have for the most part been willing to experiment with new approaches to extension in their operations in many countries. Their staff normally includes not only agronomists, but also economists and sociologists.

One of these organizations—the Compagnie française pour le
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développement des fibres textiles (CFDT)—has been primarily concerned with the promotion of cotton production in various African countries. It is equipped to handle all aspects of cotton production ranging from extension work among farmers to the operation of ginneries and the marketing of cotton. In Mali it first had only a scattered staff designed simply to encourage the growing of cotton, to collect it and gin it. Beginning in 1960, however, it was given a mandate to do general extension work in an ever-growing area which now comprises most of Mali, other than the Office du Niger, where cotton can be grown. It operates in effect an autonomous extension service for which it hires the personnel and sets the conditions of employment. It takes responsibility for getting to the farmer requisites of production such as fertilizers, insecticides, sprayers, plows, cultivators, etc., which are procured with its advice by the Mali Government and are sold on credit.

CFDT’s activities have continued to be primarily focused on cotton and it has undoubtedly been very successful in expanding the production and, increasingly, in raising the yields of this crop. It has relied on a rather dense extension network for relaying simple instructions directly to the farmers. The village cooperative groups to which the Mali Government requires every family to belong have been used primarily for the rather nominal role of selling supplies and equipment to the farmers under the general supervision of the CFDT, and, to some extent, for demonstrating the new methods of cotton growing on the small “collective fields” for which they were responsible. The CFDT’s approach has been primarily technical; and this approach was largely successful because its recommendations for cotton production—new varieties and the application of fertilizers and insecticides—had been well worked out and tested by previous research and were demonstrably advantageous to the farmers. Initially the CFDT relied on “pilot farmers,” who were given free use of plows and bullocks for two years, to demonstrate the techniques. These pilot farmers were not always well chosen, but in general the CFDT found enough farmers who did make effective use of the techniques, partly because the Government vigorously supported CFDT’s work among the farmers through its local party and administration officials. If the number of farmers who have adopted the full range of recommended inputs and techniques still represents only a small percentage of the total, this is probably because extension work does take a considerable time to become widely effective and because the limited income aspirations of many farmers restrict interest in the program.

In the central region around Ouagadougou in Upper Volta an-
other French organization—the Société d'aide technique et de coopération (SATEC)—has been in charge, since 1961, of agricultural extension work. It, too, has its own extension staff directed by French nationals. It has concentrated on organizing in the villages small cooperatives who could pioneer the introduction of new practices as a group and whose share capital could be used to guarantee loans for the purchase of draft animals, equipment and fertilizers by individual members. Like CFDT, SATEC assumed responsibility for ensuring the availability of production requisites; and, in addition, it organized and trained several groups of craftsmen to produce harness for draft animals. For a number of reasons its efforts have had only very limited success. As we have already pointed out, the basic difficulty has been the lack of a well-devised and tested “package” of improvements which seemed to farmers to be clearly rewarding. There was no profitable cash crop available for immediate introduction; the fertilizer recommendations had not been adequately tested in advance; and the use of animal-drawn cultivators has encountered more difficulties than had been anticipated. The low agricultural potential of the region and the repeated failure of previous efforts to bring about improvements in agriculture had created an atmosphere of profound discouragement and passivity which has hardly been conducive to innovation. While the attempt to work through cooperative groups was undoubtedly sound, the presidents of these cooperatives often proved incapable of stimulating any initiative among the farmers.

In the Bokoro region of the Chad the French Bureau pour le développement de la production agricole (BDPA) has conducted still another extension program since mid-1962. Like CFDT and SATEC, it has recruited its own personnel although it has also had to take over part of an already existing agricultural staff over which it cannot exercise complete control. Like SATEC, it has used cooperative groups to introduce new practices, using these groups, however, for cooperative ownership of implements rather than for guaranteeing credit for their purchase by individual farmers. While it has been modestly successful in raising groundnuts production through the use of implements, its most striking immediate contribution has been the organization of cooperative marketing of groundnuts and millet and of cooperative supply of a few important consumer items. This undoubtedly resulted in a material improvement in the “terms of trade” enjoyed by the farmers and helped considerably to create an atmosphere receptive of other innovations. Unfortunately BDPA has found it difficult to take advantage of this because, as in the central region of Upper Volta, effective means of raising output in this
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rather poor and remote area had simply not been devised and tested before the extension program was launched. BDPA’s task was made all the more difficult because its mandate has not extended to livestock, which plays an important part in the farmer’s economy, and, until recently, to water supply which critically affects both livestock and agriculture.

In the Ivory Coast the Compagnie internationale de développement rural (CIDR) has been active in stimulating agricultural production in the Bouaké region since 1961. The CIDR, though a private rather than a public organization, resembles the others in that it undertakes work on a contract basis with financing normally provided by the French Government. Its approach, however, is somewhat different. It is primarily concerned with awakening receptivity to change and arousing the farmers themselves to exercise some initiative in bringing change about. This approach, known in French as animation rurale, provides a key role for an animateur, a farmer who is selected by the villagers themselves and thus presumably enjoys their confidence. This animateur becomes the agent for introducing change into the village and the spokesman of the villagers’ desires regarding the type and direction of such change. The animateur gets help and guidance from counsellors (conseillers d’animation) who are recruited, trained and paid by the CIDR. Both the animateurs and the conseillers are trained at the same centers. Conseillers undergo a year’s apprenticeship, spending alternately a fortnight at the center and a fortnight working in the bush. They are encouraged to acquire some curiosity about, and understanding of, the economic and social structure of the villages in which they work. The animateurs are unpaid volunteers. Together with the conseillers working with them, they are expected to attend a local training center from two to five days each month in order to become acquainted with the possible improvements they might introduce in their villages and receive practical training in the application of such improvements. The primary emphasis has been on efforts to increase farm output—a task which has been facilitated by the availability of a number of innovations which had already been successfully tested on a pilot scale—but since the emphasis was on a program that would respond to the wishes of the villagers themselves, the CIDR has interested itself also in the broader field of rural uplift. It has, for example, assisted in the betterment of housing, has trained artisans such as carpenters and masons, and has encouraged villagers to till some fields in common for the sake of earning money to meet the cost of any community improvements in which they were interested. While the animateurs were urged to
bring about changes through group action, the groups have been kept small and informal, with each formed for a specific purpose that might interest its members, such as the more rational regrouping of fields for cultivation. The basic idea underlying the CIDR program has been not to replace the more usual extension service but rather to create in the village a receptivity to change and a sense of participation that would enable the more technically oriented general and specialized extension organizations to work more effectively. Although the CIDR and its animateurs and conseillers did in fact work together with these organizations, their cooperation has posed some difficult problems to which we shall revert.

Extension approaches and methods

Until rather recently agricultural extension work was largely conceived in terms of "telling" the farmer what to do. In fact, this limited conception has been responsible for much of the frustration of efforts to improve agriculture. Pre-independence governments always relied too much on direction and even compulsion; and even today African governments in their impatience to get things done tend sometimes to fall into the same error. Owing to the shortage of trained personnel and the time required to convince farmers there has always been a natural tendency to favor regulation and direction rather than persuasion. Sometimes it has been possible to achieve results in this way where in retrospect farmers have seen the benefits of enforced changes. By and large, however, the use of compulsion has done much to set back the cause of agricultural progress. In many areas such as Machakos District in Kenya and Sukumaland in Tanzania the extension service is still in bad repute because of its past association with the enforcement of soil erosion control, livestock limitations and the like. Similarly, one can cite many instances where people have reacted against basically well-conceived practices simply because they have been pressed to adopt them or because their purpose has never been adequately explained.

However, to emphasize the need for education and persuasion does not necessarily imply that the imposition of some degree of discipline, or the enforcement of certain practices, should be ruled out entirely. There remain a number of special circumstances when conformity to rules backed up by sanctions may be desirable. On costly irrigation and settlement schemes, for instance, success may be critically dependent on proper phasing, coordination and execution of the requisite farming operations. We have noted in a number of these schemes the unhappy consequences of failures to enforce certain rules. Outside of these areas, however, there are probably
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few cases justifying enforcement of practices. One might be a requirement to pull up and burn cotton stalks after the harvest whenever parasites have not been effectively controlled by spraying or dusting. Another might be a requirement to conform with certain soil conservation practices when the great majority of farmers recognize their value but are thwarted by the obstruction of a small minority. There will also be quite a few instances where the government can and should insist on certain requirements before it extends some particular form of assistance to farmers. Examples in point are the insistence in Kenya on land enclosure before permission is given to acquire European-type cattle or the insistence on bench terracing before coffee seedlings are supplied. However, when regulations are necessary, they are unlikely to be fully effective unless they are explained in such a fashion that most of the farmers understand their justification.

Even though it is now generally recognized that an extension service should rely primarily on persuasion, there is still insufficient emphasis on the need to convert it gradually into a means for two-way communication with the farmer. In principle, it must learn from the farmer what his problems are, why he does or does not do certain things, what labor, land and other means of production he has at his disposal, what ambitions and desires he has, etc. The extension worker should be both the adviser and interpreter of the farmer. He must be able to relay his knowledge of the farmer’s thinking, problems and requirements so that those in the government concerned with research, credit, requisites of production and marketing can effectively tailor their proposals for improvement of agriculture to the farmer’s needs and limitations.

In practice, the extension service can only be expected to assume this broader role gradually as better people are attracted, particularly at the subprofessional level, and training is greatly improved both in depth and in orientation. Today the extension workers who are in direct and continuing contact with the farmers are not for the most part sufficiently well trained and sophisticated to make a proper diagnosis of the farmer’s situation and problems or to articulate this diagnosis in such a way as to make it readily comprehensible. Their training has not hammered home to them the importance of understanding the farmer and his point of view or tended to arouse in them an awareness of the many factors conditioning the farmer’s reaction to innovation. Even if the calibre and education of subprofessional extension workers are greatly improved, this does not mean that they will be equipped to make a competent diagnosis of farmer’s problems on their own, and to act continuously as lucid interpreters and
spokesmen of the farmers. Such extension workers will need con-
tinuing guidance from their superiors, and at times, special direction
from agricultural economists and social anthropologists in con-
ducting inquiries among farmers designed to collect relevant data
and illuminate actual and potential reactions to government mea-
ures for improving agriculture. The use of extension personnel in
such investigations can greatly contribute to their training.

The role of leaders

Successful extension work is contingent on proper recognition of
the leaders and other prominent individuals whose influence and
support for innovations must be obtained. In recent years this task
has sometimes been made more difficult because of the coexistence
of, and changing relationships between, two types of leaders—those
identified with the traditional society of lineage and tribal groups,
and those emerging from the new and more modern institution of
the political party. There may be some identification of the two, but
more often they are different. Their outlook may diverge markedly,
with the traditional leader less apt to be committed to change.

Functions of the New Political Leadership. Where the new political
leaders command considerable support in the rural community, they
may be critically important to agricultural extension. During the
struggle for independence in Kenya political opposition often
frustrated efforts to improve agriculture because these were identi-
ified with the colonial government; but since achievement of in-
dependence, opposition in many areas has given way to outspoken
appeals for support of the extension service. Similarly, the CFDT
in Mali has often been vigorously assisted by dynamic local workers
of the political party which controls the government and ad-
ministration. In Sukumaland we noted that local TANU party
workers had been entrusted with the primary responsibility for
mobilizing farmer support for the new agricultural development
efforts. However, there are certain dangers in the relationship be-
tween political organizations and extension services. In their anxiety
to get rapid change, political leaders may rely too much on putting
pressure on the farmers just as former governments sought, largely
in vain, a short-cut to agricultural development through a con-
siderable measure of regulation and compulsion. Change is unlikely
to be permanent if farmers are pressed rather than persuaded to
adopt it; and if the change proves in addition to be ill-considered,
the farmer’s resistance to new efforts to raise his output may be all
the stronger. Political leaders sometimes have shown a dangerous
tendency to dictate the adoption of technical methods without ref-
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ference to their suitability or cost. An extension service should not be allowed to fall under political control, for its substantive work could be irretrievably damaged if its fate were too intimately linked with the frequently changing fortunes of particular leaders or particular parties.

Political leaders obviously have an important and legitimate role to play in determining development goals and in enlisting popular support for their attainment. They have a great responsibility for arousing among farmers an awareness of problems arising out of the growing pressure of population on land and of the need for positive steps to conserve natural resources, to modify forms of land tenure and to intensify production. As we have stressed in preceding chapters, success in agricultural development is critically determined by the timeliness of government intervention; and it is in this respect that local and national political leaders can be of great assistance in securing acceptance by farmers of the considered judgments of professional agriculturists, economists and social anthropologists.

Approaches through Traditional Authorities. In many parts of Africa traditional authorities—chiefs at various levels or elders of clans and smaller kinship units—still play a very important role. In Upper Volta, Chad and Mali, for instance, we found that the village chief was the mediator between villagers and the outside world. The approval of the chief had to be obtained before conversations with villagers could be initiated and extension work undertaken. Once an entrée is obtained, a feeling of trust between the extension worker, the community and individual farmers must be developed. It has been observed by social anthropologists that the first people to adopt change often do so not so much from conviction of its merits but rather on the basis of the personal confidence they have developed in the outsider who has recommended it. Subsequent adoption by others, however, tends to depend on the success achieved by the original innovators and the extent to which others are convinced that their position is sufficiently similar to make it possible for them also to adopt the change. In other words, the more widespread adoption of the recommendations of the extension service depends largely on whether the initial farmers or groups of farmers with whom a start is made are considered influential or representative. CIDR, as we noted, asked each village to select a farmer for training as animateur, but the first one was often nominated only to test the nature of the new program and the intentions of its proponents. After the village leadership was convinced of CIDR's good faith, it frequently replaced the farmer originally selected with one considered more representative of the village. In the case of the CFDT
in Mali, the success of the pioneer farmers employed to demonstrate improved methods of cotton cultivation also depended critically on their standing in their village community.

**The group approach**

In extension work it is always important to determine to what extent attention should be focused on groups of farmers as compared with individual farmers. The circumstances that dictate a group approach are briefly discussed below.

In a rather traditional and egalitarian society the best and only practicable way of getting new methods and improvements adopted may be through work with groups of farmers. Attempts to single out "progressive" or "better" farmers and to use them as demonstrators have often failed because the farmers have been regarded as "deviants" and have found themselves isolated and the object of suspicion and hostility. The areas where the innovator is likely to experience this kind of alienation are undoubtedly diminishing to some extent with the impact of modernizing influences and with the identification of the new political leaders of Africa with progress. However, in 1964, we found evidence that in parts of Central Nyanza, Machakos and Sukumaland some progressive farmers still felt isolated and alienated from their community. Elsewhere we have already noted that in Central Nyanza significant progress in cotton cultivation was made when action was concerted on the basis of kinship units. In Upper Volta, Chad and part of the Ivory Coast village society is still traditional enough to make the "group approach" to change necessary. However, the extension worker must be aware of the conflicts and dissension that frequently characterize the community. Traditional antagonisms, for example, may make it impossible to establish an effective cooperative including all village families. Even smaller kinship units may be rent by strife to such an extent that they cannot be used to cooperate effectively in introducing change. In the case of SATEC in Upper Volta and BDPA in the Chad, it was by no means clear to what extent and how the effectiveness or the membership of cooperative groups was being impeded by factors inherent in the social structure of the villages and to what degree the heads of these groups commanded the confidence that enabled them to exercise leadership.

Even where effective progress can be made by focusing on individual farmers, staff shortages usually make it impossible to maintain close contacts with many such farmers and, therefore, put a premium on using group techniques or working through groups. In Kenya as well as other parts of former British Africa the agricul-
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tural service has relied heavily on “field days” on which farmers in the neighborhood are asked to attend some sort of “demonstration” on a farm. This teaching technique has proved to be of considerable value, provided attendance is not too large. In general, however, it would seem more effective to work with farmers who are organized in a more or less permanent group that provides a continuing point of contact for the agricultural field staff and enables farmers to support each other in programs of improvement and development. Thus in Kenya’s Elgeyo-Marakwet District, a number of farmers’ clubs, with whom the local agricultural staff met regularly, appeared to be doing good work. However, the possibilities of working through other organized groups have not always been fully exploited. We have already mentioned that little attempt has been made to explore the possibility of using the various types of self-help groups which have been organized or revived by community development officers for the purpose of stimulating interest in agricultural improvement. In many cases, too, it seemed to us that the extension service in East Africa was not making full use of cooperatives as a channel for propagating better crop and animal husbandry. Effective extension work does require close association with the farmers’ own organizations.

In some cases there are special reasons for persuading a large number of farmers to advance more or less simultaneously. This we noted to be particularly true of cotton cultivators in Central Nyanza and Sukumaland. In both these areas farmers who planted their cotton early but in small fields often suffered from the cotton pests harbored in nearby fields of maize and sorghum which neighboring cultivators continued to plant earlier than their cotton crop. On the other hand, where farmers were persuaded to pool fields in order to grow cotton in larger blocks and also to plant early, this danger was considerably reduced. It was also evident that the opening of cotton stores and ginneries in both areas was geared to the late planting practices of the great majority of farmers, so that those who did plant early found it necessary to store their own cotton and run the risk of deterioration consequent upon inadequate and prolonged storage.

Concentration on the receptive

Under all conditions limitations of staff necessitate some degree of concentration in order to get the best results. This concentration may be on people who are most receptive, on areas that have the greatest potential, or on types of innovations that may win relatively easy acceptance.

Differences in receptivity may emerge only slowly in societies
which remain largely traditional and have had little knowledge or experience of the outside world, whether through formal education or the informal learning and stimulus derived from the practice of other occupations or from certain types of labor migration. Thus in Upper Volta, Chad and Mali there did not appear to be any significant "progressive" elements among farmers to which the French organizations engaged in extension work could readily appeal. Occasionally one encountered veterans of overseas service with the French armed forces whose experience had obviously broadened them and had also made them more receptive to change, but only provided that the enjoyment of a veteran's pension had not deprived them of the desire to earn more money. For the most part, however, there seemed to be no great initial differentiation among farmers in their methods of farming.

As some degree of improvement in farming is achieved, differences in the degree of progress among farmers become increasingly evident. Some people will prove to be much more energetic, enterprising and open to change than others. At this stage, it becomes important to identify as far as possible the type of people who are responding to extension advice so that future extension efforts can be more effectively focused on those likely to prove most receptive on the basis of past experience. We were impressed with the importance of this in those areas of East Africa where there had obviously been considerable agricultural progress but where at the same time there were striking differences in receptivity.

In Kenya we made some attempt to determine the characteristics of progressive farmers with whom we came into contact. In general they apparently shared some sort of experience which had broadened their horizon and increased their knowledge or skills. Such experiences were quite varied. In some instances it was formal education; for instance, school teachers who were able to attend to their own farm were generally progressive. In some cases it was experience as a trader or independent artisan which, incidentally, might also have provided a modicum of managerial experience, particularly experience in the handling of money, and some funds for investment in the farm. In the great majority of cases it was experience in paid employment whether in private enterprise or in the government. It was obvious that employment on a European farm had often significantly increased receptivity to change. Previous employment in protective services (prisons, army, police) apparently developed characteristics conducive to better farming—perhaps in the form of a readier disposition to listen to "authority" (in this case the agricultural service) and of more disciplined work habits. Conversely, we found that the
absence of outside stimuli and experience contributed to the preservation of a relatively static society. Among the most conservative farmers we found in our extended field trip in East Africa were the Sukuma who had a rather low level of education, little or no work or travel experience outside their own locality, no large and efficient European farms in their midst, and, generally, scant exposure to outside stimuli. They therefore manifested relatively low levels of aspiration.

A few other characteristics of “progressive” farmers that we observed in East Africa are worth mentioning. In areas where land could be bought or sold we found that those who had in whole or in part bought their farm were almost always more energetic and progressive in their outlook. The buying of land is in itself often a sign of enterprise, and we noted that those who had used hard-earned cash to purchase their land were generally determined to get something out of it. On several occasions when we met with a group of farmers whom the local agricultural staff evidently thought progressive, it developed that a substantial majority had bought at least part of their land. Finally, we found quite a few women in the category of progressive farmers; widows or women whose husbands were working elsewhere and thus not living at home. There was a large measure of agreement among the agricultural staff on the general proposition that they were often more receptive to advice and instruction than men, but that women in most cases lacked the opportunity or authority to apply advice. When they are widows, however, or their husbands leave them in charge of the farm (and the expenditure of the income therefrom), they have both the incentive and the authority to apply improved practices.

We do not suggest that the type of people we have mentioned invariably make good farmers, but only that they seem to provide the best potential for extension work. In fact we noted a number of farmers who in buying more land had overreached themselves and were no longer capable of managing their farm land effectively. Similarly, we met a number of people who undoubtedly displayed enterprise and energy by simultaneously engaging in farming, trading or one or more other occupations but who did none of them competently. However, people with outside experience of the types indicated have the potential capacity to become good farmers provided they can and will devote a substantial part of their time to the management of their farm.

In some parts of Kenya the number of people with experience that made them receptive to change has been large enough to justify a substantial concentration of extension effort. Thus in the Central
Province the success achieved with perhaps 10–15 percent of the farmers has had a great impact on the development of cash cropping and of dairying with exotic cattle. Yet there are dangers in prolonging such concentration unduly, no matter how profitable it may have been initially. We found, for instance, that many progressive farmers soon reached a stage where the still relatively untrained extension worker had little or nothing to teach them. However, this does not prevent many extension workers from prolonging such contacts because of the prestige which relations with the more progressive farmers give them. If help and progress are confined to a small minority, the gulf between the progressive and those who for various reasons do not feel readily able to emulate their example is likely to widen to a dangerous degree.

Development almost inevitably results in greater disparities in income, but a special effort may well be necessary to help the lagging in order to prevent social tensions from becoming intolerable. In Kenya's Central Province, for instance, the smaller farmers who form the great majority but have relatively few resources have largely been left behind in the march of progress. They have benefited somewhat from wage labor opportunities on developing farms, but their own farms for the most part continue to be devoted almost entirely to subsistence production. The gulf separating them from the progressive farmers has become so great that most of them despair of ever bridging it. Their plight does not vitiate the case for concentration of extension efforts, but does illustrate the importance of recognizing that there are groups of farmers with different types of problems and requirements. In the Central Province the larger farmers had little difficulty in setting aside land for such crops as coffee, tea, and pyrethrum or for grass to keep dairy cattle. But the problems of the smallholders with three to four acres of land and even less could not be met by the traditional policy of the agricultural service of “grafting” some sort of cash crop or dairying on to subsistence farming. Their problems appeared to require a special program concentrating perhaps on improving yields of subsistence crops and on types of commercial farming activities such as pig raising, poultry keeping and vegetable growing which might be better suited to small holdings.3

3 Our study of the development of coffee production on Mount Elgon in Uganda also shows that the benefits of this development would have been more widely and evenly distributed if special efforts had been made to devise and disseminate methods to raise the yield of bananas, the staple food crop, thereby enabling farmers with small holdings to devote a portion or a greater portion of their land to coffee.
Concentration on Areas

There are at least three different reasons for focusing extension efforts on particular areas. One may be to test the content and methods of an extension program and then gradually broaden the area of operations as the program proves itself and the farmers have shown a readiness to accept it. This has been the approach, for instance, of SATEC and BDPA in Upper Volta and Chad respectively. Their experience tends to show that there is often too much pressure to extend operations before conditions merit it. Another, related, reason for concentration may be the difficulty or seriousness of the problems in a particular area. This has been part of the motivation of the SATEC and BDPA programs mentioned above, though in both cases the efforts are likely to be very limited in effectiveness because of the comparative lack of tested and rewarding means of raising farm output. It was also the reason for concentrating considerable personnel during the 'fifties in the Machakos District in Kenya where a special campaign appeared to be necessary in order to reverse the serious degradation of land and improve agricultural productivity. Although the campaign in this case had some lasting results, particularly in terms of soil conservation, its effectiveness was also limited by the inability to devise more profitable farming systems for large portions of Machakos as well as by the inadequate means of production available to farmers.

The most important reason for concentrating extension work is undoubtedly the varying potential within any country for an increase in output. If the national output is to be raised quickly and significantly it is manifestly best to concentrate on the areas with the greatest development potential in terms of both human and natural resources. However, both governments and international institutions concerned with development must recognize that the goal of maximizing total production may have to be tempered by the need to have various regions within the country share in the fruits of progress. Where, as in Kenya, tribal and other barriers prevent the easy movement of people from overpopulated or poorly endowed areas to less populated or richer areas, it is hardly possible for the government to focus all its efforts on regions of high potential. By and large, however, the tendency in Kenya has been not to fall into the error of excessive concentration, but rather to dilute the effect of extension personnel by attempting to carry out too uniform a pattern of staffing throughout all the farming areas.

Considerable discussion has been devoted in the past to the determination of desirable ratios of extension workers to farmers. In
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1962 a conference on extension in East Africa came to the conclusion that, despite the difficulties of establishing a general rule on this subject, the minimum ultimate objective should be a ratio of between 1:350 and 1:1,000 which was said to prevail in the advanced countries.\textsuperscript{4}

Specific ratios can only be determined in the light of conditions prevailing in specific areas. It must depend on the potentialities for increased production, the degree of sophistication and technical level of the farmers, the complexity of the methods required for raising output, the density of the farm population and the mobility of the extension workers. Sometimes a temporary but significant increase in the ratio has given a decisive impulse to the adoption of a particular innovation which was demonstrably effective in raising output. Thus on Ukerewe Island (Tanzania) in Lake Victoria it has been possible in recent years to secure the widespread use of fertilizers by following up convincing demonstrations with an expanded extension effort that involved the employment of one extension worker for about 300 farmers. There is little doubt that the policy of increasing the number of extension workers carried out by CFDT in Mali since 1960 has been quite effective in popularizing the cultivation of cotton and raising yields. On the other hand, SATEC's experience in Upper Volta illustrates that the justification of a "high-density" extension network must always be considered in the light of the effectiveness of known means for increasing agricultural output.

It is useless to pretend, however, that one can determine very accurately in advance whether the results will warrant extension efforts on a particular scale. Before substantial resources are committed to an extension campaign, it is, of course, necessary to arrive at some judgment as to whether the potentialities for greater agricultural output over time are likely to make the extension effort worth while. The risk of misjudgments may be minimized by trying a given extension program first on a pilot scale, but even then there may be considerable range of error in predicting the rate of increase in output over the rather lengthy period that is often essential to get significant results. In retrospect it is often found that such progress as has taken place is the result of a complex of interacting factors none of which can really be assessed in isolation.\textsuperscript{5}


\textsuperscript{5} On this point, see our evaluation of progress in Nyeri in the Kenya case studies in Vol. 2.
Concentration on subject matter

Concentration in terms of subject matter is desirable, at least in the initial stages of extension work, but it is often impracticable to focus on a single crop or isolated improvements for a long time. It has in many cases proved feasible to introduce a new crop, a new variety or a new practice without immediately undertaking a transformation of the whole of the farmer’s cropping pattern. In fact the introduction of a new remunerative crop has most frequently initiated agricultural progress. Sooner or later, however, the need for a broader and more comprehensive approach will probably emerge owing to the interlocking nature of agricultural improvements. Where there are limitations on the supply of land or labor the general adoption of a new crop may involve the farmer in decisions about the allocation of limited resources or force consideration of ways and means to widen a bottleneck by the use of new implements. The smaller farmers in the Bugisu District of Uganda could not share fully in the benefits that flowed from the introduction of arabica coffee because they were not enabled to increase the yields of their food crops, particularly of bananas, and thus release more land for coffee. We have already mentioned a somewhat similar situation in Kenya’s Central Province. In Central Nyanza it may not be possible to maintain the initial advances in cotton cultivation made by the group schemes unless there is some resolution of the conflicting claims of cotton and food crops on available farm labor supply at critical times. The adoption of a new annual crop is virtually bound to bring to the fore ultimately the problem of maintaining soil fertility, whether by appropriate rotations or the application of fertilizers and manure or both. In the field of livestock, the adoption of improved breeds and better standards of management has often proved impossible, as in Kenya, without land enclosure; and the adoption of animal traction tends to require attention, as we have seen, to broader problems of associating livestock with agriculture that involve fundamental changes in farming.

It is in the consideration of the farm problem as a whole that extension services have generally been most deficient. Not only is there often insufficient appreciation or understanding of indigenous farming patterns, but inadequate attention is also paid to the impact of particular innovations on such patterns. In Kenya we found that in most districts where written materials were issued for the guidance of extension workers these almost invariably dealt with particular crops in isolation and therefore did not take into account the practicability of the recommendations in relation to other crops and
farm activities. There was, however, a commendable effort to deal with the farm as a whole by training extension personnel to prepare farm layouts and farm plans for progressively-minded farmers in the more promising agricultural areas. The layout provided a fairly simple land-use scheme, while the farm plan provided a more sophisticated program of farming involving regular rotations. While this was undoubtedly a hopeful approach, in actual practice many of the farmers did not follow the layout or plan. In part, at least, this seems to have been due to the rather schematic nature of the layouts and the largely technical orientation of the plans which did not fully take into account either the economic aspects or the constraints within which the farmer had to conduct his operations.

**The scope of extension**

The experiences with extension work which we have briefly described raise a number of issues regarding the scope and organization of an extension service. Here we shall deal first with some of the problems involved in delimiting the scope of activities.

**Responsibilities for supply**

A critical question is whether the extension service should have the responsibility for ensuring that farmers have access to production requisites. Certainly if the extension program calls for the introduction of better implements and for the use of fertilizers and insecticides, provision must be made for their supply. Cooperatives and private trade usually do not provide the answer in the early stages of agricultural development. True, cooperatives may be formed, but they will probably have to be virtually managed by extension personnel until the farmers have made some progress and acquired the experience and education needed to run such organizations. Private trade is unlikely to provide adequate supplies at tolerable prices until demand reaches a certain volume. In Kenya we noted that both cooperatives and commercial firms were performing a satisfactory supply function in or near areas where there were many European farms. However, in traditional African farming areas equipment, fertilizers and insecticides were often unavailable unless farmers were prepared to travel a considerable distance, and extension workers often did not know where they could be procured. It may be argued that farmers should be expected to go to some trouble, if necessary, to get supplies, but traditional farmers are unlikely to do so particularly when they may well have lurking doubts about the continued value of some of the "new inputs" they are being urged to use.
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The French extension organizations which we saw operating in Mali, Chad and Upper Volta could hardly have made any progress without taking responsibility for getting supplies and equipment to the farmer's doorstep. In Mali particularly we were impressed by the important contribution to the expansion and improvement of cotton cultivation which CFDT's supply function was making. Farmers were much more inclined to fertilize and spray their cotton when the necessary supplies of fertilizers and insecticides were made conveniently accessible and their use was even made relatively "painless" in so far as no cash outlays were involved and the cost deducted from the sales proceeds of the cotton.

It is sometimes objected that a government extension service is not very well suited to undertake essentially commercial operations such as those of supply; and, indeed, this argument is used by some as an additional justification for setting up an autonomous extension organization that would be better equipped to handle this and other tasks. People trained to do extension work may, of course, not be equally capable of handling supplies. However, personnel can be specially trained and assigned to perform this particular function. Moreover, the responsibility assumed by the extension service can be kept quite simple. For instance, the actual procurement of equipment and supplies and their transport to conveniently located depots might be entrusted to a special agency of the government or to a business firm under contract with the government. It would then be sufficient if the extension service could command the necessary means of transport to get the supplies to farmers as and when the need arises. In any event, this responsibility could in time be transferred to cooperatives or to private trade.

Responsibilities for credit and cooperatives

Experience also points to the desirability of giving the extension service some responsibility for credit and cooperatives. It should not generally be responsible for the actual extension of credit and, save in exceptional circumstances, for the collection of credits. However, extension workers are the only ones sufficiently acquainted with the farmer to advise the credit agency whether the loan applicant can make effective use of the credit. Similarly, the extension service

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6 See the subsequent discussion regarding a separate, autonomous extension service.

7 Where, as in the case of the CFDT in Mali, an extension organization is responsible for supplies and marketing and the cost of supplies is automatically deducted from market proceeds it is unlikely that the extension service will earn the opprobrium of farmers for acting as debt collectors.
can hardly escape some responsibility for ensuring that farmers use credits for the purposes for which they are extended. For cooperatives the extension service must normally share responsibilities with the government department specially charged with such institutions. When formal or informal cooperatives are to serve as instrumentalities for bringing new inputs and techniques to farmers or for marketing agricultural products, it is important that the initiative for their formation come from farmers and the extension agents working with them. In such cases extension workers are also best qualified to advise cooperatives on their substantive responsibilities, particularly since these are closely related to extension objectives. On the other hand, the government cooperative department is responsible for ensuring that cooperatives are organized and managed in conformity to national law and are held financially accountable. The training of cooperative staff should be a matter for close consultation and collaboration between the extension service and the cooperative department.

**Concern for rural improvement**

More controversial is whether the extension service should broaden its scope beyond activities rather directly related to agricultural development into the more general field of rural improvement. Sometimes this may be necessary in order to win the confidence of people and create an atmosphere of receptivity to measures directly concerned with agriculture. Such may be the case when the sinking of a well for drinking water or the establishment of a village dispensary responds to deeply felt needs. We have already mentioned that BDPA in the Chad created a favorable atmosphere by actions that made sugar, the most important consumer item, considerably cheaper and that raised the price which farmers obtained for groundnuts and millet in the market. There is a serious danger, however, that the extension service will undertake more than it can handle. Where the emphasis has been put on the employment of "multipurpose" village extension workers as in India and Pakistan, it has often been the experience that much time and energy is wasted in attempting to do too many things at the expense of the prime need to raise agricultural output. In the Ivory Coast we found that the CIDR had managed to reconcile some measure of concern for village improvement with priority attention to agricultural production, but constant vigilance must be exercised to avoid a dispersion of effort. However, the extension service should be responsible for calling attention to certain situations which may not fall within its competence but which have an adverse effect on production. Thus it
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may well stress the importance of an attack on certain endemic diseases which sap the vitality and work capacity of farmers, but it should hardly be expected to devote much attention itself to health education and village sanitation.

Extension and animation rurale

The relationship of agricultural extension to animation rurale remains to be considered. We question that two separate services are really needed. The establishment, in some cases, of a special service for animation rurale reflects a basic dissatisfaction with the shortcomings that often characterize agricultural extension—its tendency to adopt a rather narrow technical approach which does not take into account all the factors affecting farmers’ responses, and to tell farmers what is deemed good for them rather than to find out what type of help would conform to their needs. The objectives of the CIDR, focused primarily on agricultural progress, were no different from those of an agricultural extension service; and we did not detect any significant differences in the technical knowledge of agriculture between the agents of the agricultural field service and the conseillers trained by the CIDR to advise the animateurs. There seemed to be no convincing reason for the two to exist side by side.

Animation could in theory be used during the initial stages of agricultural development to stimulate interest in and receptivity to change, and subsequently give way to a regular, more technically oriented agricultural extension service. However, this assumes erroneously that an atmosphere responsive to change can be created in a comparatively short and defined time period and that thereafter innovations will be readily accepted. The extension worker finds receptivity a continuing problem and must always be equipped to appreciate all the factors which condition farmer responses. Even in well-developed countries it has been found that “the farmer’s actions are greatly influenced by customs, norms, views and habits, in short, by the underlying pattern of culture which determines to a considerable extent his accessibility to the methods propagated by the extension services.”8 We therefore believe that animation rurale should be an integral part of every extension service.

Relationships to community development

A somewhat similar problem is posed by the relationship of agricultural extension to the community development service which

exists in various African countries. In Kenya and Tanzania, community development workers have been primarily active in forming or reviving self-help groups and turning them to such community tasks as the building of roads, schools, community centers and the like. Usually their work has not had a direct bearing on agriculture, although here and there in Kenya community development officers have been instrumental in awakening interest in changes in land tenure. Though the community development service and the agricultural field service could be considered to be pursuing parallel and complementary rather than overlapping activities, the need for coordination still exists. Thus the question arises whether the self-help groups promoted by the community development service should be exclusively directed toward the types of community projects mentioned above or could and should also be utilized to stimulate interest in improved farming. We have already indicated our conviction that the satisfaction of keenly felt needs in the nonagricultural field may at times facilitate the acceptance of change in agriculture, but that a concern with rural uplift as a whole can easily divert attention from the primary requirement of raising farm production. So long as separate community development and extension services exist, their activities should be closely coordinated so that a properly balanced program of rural improvement can be pursued.

Some organizational problems

The organizational problems that arise in connection with an extension service are necessarily closely related to the fundamental conceptions regarding its functions and its scope.

A separate extension service?

An important issue is whether the interests of the farmers would not be better served by a separate service which concentrates entirely on extension work. There are weighty arguments in favor of such a separate service. A distinction can be made between (1) the administrative services within a ministry of agriculture which are responsible for planning and formulation of policy, for agricultural legislation and regulations, for budgeting, for research and for general control and supervision, and (2) the service which must concentrate on the task of involving the farmers in agricultural development within the framework of such overall goals, policies and budgets as have been set by the headquarter services of the Ministry. As long as extension is just the field projection of an agricultural administration, it is less likely to serve its two-fold function of transmitting knowledge to the farmer and of communicating the views, prob-
problems, and desires of the farmer to the government. Extension is unlikely to succeed unless it abandons the “top-down” approach that has so often characterized it in the past and, instead, enables farmers to identify and associate themselves more definitely with efforts to improve their own lot. Although a separate extension service may also succumb to the danger of considering its task solely as one of “instructing the ignorant farmer,” its preoccupation with the problem of getting the farmers’ confidence and participation probably makes this danger less acute.9

Some believe a separate extension service should also be autonomous in the sense that it should have much greater freedom than the regular government services in hiring, dismissing, promoting and transferring its personnel, in determining whatever means are necessary to achieve its goals, and in expending such funds as the government may make available to it annually. It is argued that extension requires more flexibility and a more imaginative approach than a routine government service and that neither can be achieved without a large measure of freedom from bureaucratic regulations that often hamper effective and rapid action. It is also contended that an ordinary government department or service cannot be expected to assume responsibility for timely and efficient deliveries of production requisites whenever these are essential to farm development.

There is no doubt that government extension work has frequently suffered from bureaucratic inflexibility, particularly in the deployment and promotion of personnel. For example, there is little justification for insisting that extension personnel responsible for the critical continuing direct contacts with the farmers should invariably be the lowest paid irrespective of their experience, or that their promotion should inevitably be attended by removing them at least one step from direct contacts with farmers. Nor is there much justification for adherence to an inflexible geographic distribution of personnel when a concentration of personnel may prove more effective in achieving results. Time and again we encountered instances where it had proved impossible to obtain personnel for critical jobs because of inflexibility in pay scales and allowances. All these are undoubtedly serious handicaps of the normal government services. On the other hand, there is unlikely to be an organizational panacea

9 If a separate extension service is established, it would need to provide for organized association of farmers with the service at its various levels and at the top for a coordinating and policy-making council representing various government departments and agencies whose cooperation in the extension effort is vital.
for them. Moreover, such problems must be solved within a broader framework. It is probable, for instance, that a case for autonomy could be made equally well for many other government services and departments, particularly now that governments go far beyond their normal tasks and have assumed far-reaching responsibilities for development in many fields, all of which call for initiative and flexibility in operations. Thus the effective organization of agricultural extension work is part of the broader and unquestionably urgent problem of revising government procedures and regulations so as to adapt them to modern requirements.

Employment of foreign organizations for extension

The need for a more flexible and experimental approach has sometimes been met by employing a foreign organization to carry out extension work. We have described some cases of this type earlier in this chapter, just as we noted in Chapter III that French organizations have also been given continuing responsibility for agricultural research in a number of countries. Governments may be more reluctant to entrust foreign organizations with extension work than with research because extension requires close contacts with many people and may therefore be considered to have a more political character. There may, however, be some justification for doing so when (1) senior staff is seriously deficient in numbers and quality, or (2) there is need to try out, on a pilot or near-pilot scale, new and experimental extension approaches that may call for considerable flexibility in handling personnel and in modifying methods. Where substantial technical assistance for extension is in any event required from abroad, the effective organization and employment of a number of individuals obtained under separate contracts is often difficult. Under such conditions it may be more effective to contract for a "package of assistance" with an organization which can take on the task of managing and directing the personnel made available and also give it the benefit of organizational experience with agricultural development work elsewhere. The disposition to take advantage of assistance in this form might be greater if there were organizations in a number of developed countries that could furnish this service or if international organizations like FAO were equipped to do so.

Experience shows that the employment of such organizations is likely to be effective only if definite provision is made for training of local extension workers and supervisors with the necessary language skills, and if the contract is for a period sufficiently long to permit the extension work to have some impact. Sometimes the commitment may be much too short as in the case of BDPA in the Chad where
the need for annual renewal has made it difficult to plan and, indeed, to make provision for training. Although training of local personnel should be one of the principal objectives, it tends to be neglected partly because contracts do not make sufficiently explicit provision for it and partly because both contracting parties are anxious to see extension have an early impact on production. In the case of all French organizations whose work we reviewed there was some "on-the-job" training, but it seemed to us that only the CIDR gave adequate priority to systematic training.

The issue of a unified extension service

An organizational issue closely related to the scope of extension activities is whether there should be a "unified" extension service through which all contacts with farmers, as members of a rural community, should be channeled. In a traditional society which has had only limited contacts with the outside world people are easily confused when they receive advice and instructions from various sources. This does not mean, however, that there should be a single extension service for all government agencies that may have some role to play in the improvement of rural life, whether in education, health, agriculture or still other fields. The task of such a multi-purpose worker is, to be sure, to invoke the assistance of various government ministries or departments that may be needed by the villagers; but we have already commented on the danger of excessive dispersion of effort inherent in this approach. While coordination of effort is necessary, it is hardly feasible or desirable to channel contacts with all government services concerned with rural improvement through a single extension organization or extension worker.

However, in the more narrowly delimited field of agriculture and livestock, a stronger case for a unified extension service can be made. Even here there are problems. The handling of extension work on livestock and agriculture is one of them. In Kenya a division of competence has been worked out leaving animal disease control, animal breeding and artificial insemination to the veterinary staff, but making the agricultural staff responsible for extension in animal husbandry work as well as agriculture. While veterinarians obviously need to retain jurisdiction over disease treatment and control, it seemed to us that a more desirable solution would have been to vest responsibility for all extension in a single agency.\[^{10}\] The problem

\[^{10}\] The present division of responsibility, for example, makes it unclear who is charged with the task of educating farmers to recognize signs of heat in a cow. The failure to recognize such signs often makes it necessary to repeat inseminations.
becomes particularly serious when a number of agencies concerned with agricultural development exist side by side. We have already suggested how the extension service might be related to the institutions handling farm credit and cooperatives. Another problem arises from the coexistence of different organizations that are responsible for the promotion of particular crops like tea, coffee, cocoa, cotton, etc. A number of these have been established in various countries and are engaged in extension work. In the Ivory Coast there is one for virtually every commodity sold in significant volume. Sometimes, as in the case of the CFDT in Mali, a specialized crop organization is made responsible for all agricultural extension work. Our observations lead us to believe that such specialized organizations should generally approach the cultivator only at the request and under the “umbrella” of the general extension agent. The general agent is the only one who through continuous contacts can win the trust of the farmer, be expected to know his problems and capacity and keep to the fore the need for developing his farm as a whole. The general extension worker undoubtedly must be able to call in experts specialized in particular crops or livestock, but these should be used primarily to instruct and advise him or, at his behest, to demonstrate particular techniques or perform certain services for farmers.

A concluding remark

It is difficult to write any general prescriptions for the proper organization of extension services. It is probably unwise to adopt organizational patterns that represent too abrupt a departure from prevailing administrative traditions, particularly if the existing organization works tolerably well and can, with some changes, be made to work better. Personnel are normally more important than organizations. The orientation given to personnel and the spirit that animates them are likely in the end to be most critical in the quality of extension work.

Recruitment and training of extension personnel

Our study of experiences with agricultural development has not been concerned directly with methods of recruiting and training personnel.

11 An FAO/CCTA conference on extension work in East, Central and Southern Africa, which was held in Arusha, Tanganyika in February 1962, agreed on the importance of “greater participation of the people themselves in planning their own extension programs” but after discussing the concept of a separate extension service held that there was “no particular organizational structure which would suit all countries.” See FAO Report on the Agricultural Extension Development Center for East, Central and Southern Africa, pp. 18 and 27.
extension personnel. We shall therefore offer only a few observations arising out of our contacts with such personnel in the field.

One issue is whether extension staff at the lowest personnel level should be drawn directly from practicing farmers and be allowed to combine continued farming with extension work. We have noted, on the one hand, the use of unpaid, volunteer farmers for extension work as animateurs in the Ivory Coast, and, on the other hand, the practice in Kenya of recruiting local extension workers—the Assistant Agricultural Instructors or AAI’s—from among farmers and permitting them to continue farming. In Kenya the primary motivation of this practice has been the saving in pay resulting from the employment of people who do not need to rely wholly on their income as extension agents.

The contention is often made that extension work should not be a part-time job or be carried out by people who are unpaid or inadequately paid and who generally possess insufficient educational qualifications for training. It is true, of course, that a volunteer worker may tire of his job or give it but scant attention. In Kenya the AAI in many cases is neither a good farmer nor a good extension worker. On the whole, however, we believe it is important to rely on practical farmers as extension workers, or—more precisely—as assistants to full-time extension workers and as intermediaries between the farmers and the extension service. Provided they are selected so as to be reasonably representative, they can develop a much better rapport with their fellow farmers. They can in fact become the means of identifying and associating farmers more closely with the extension service. Their knowledge of local conditions and the local vernacular may help to make them more effective. Since they cannot be transferred, the continuity that is so important to effective extension work can be ensured. As practical farmers they are apt to have a better appreciation of the types of improvements that are likely to prove feasible and profitable. Whereas it has often been found that people with academic training in extension are at times incapable or unwilling to carry out practical demonstrations, the “farmer extension worker” does not suffer from this shortcoming.

These potential advantages are likely to be realized only under certain conditions. The use of unpaid volunteer animateurs may well be practicable only where people are settled in villages and the animateur can be in touch with many farmers without devoting con-

12 While our own observations confirm this, we also encountered a considerable number of AAI’s who had a much better grasp of farm problems than their superiors, the Agricultural Instructors.
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ciderable time to travel. Even then it can be expected that there will be a considerable turnover in animateurs, which, however, need not be a serious drawback since the training and experience received will continue in some measure to benefit the community. Where, as in much of East Africa, farmers live on scattered homesteads, the farmer extension worker can hardly be expected to perform his task without pay. In both cases their ratio to the number of farmers will obviously need to be considerably higher than would be the case with full-time extension workers. They need to be selected in such a way as to be representative of the community they serve. Their primary responsibility is to farm well themselves, for their farms must obviously reflect the effectiveness of the extension program they are propagating. Their employment should therefore be made contingent on their remaining good farmers. Since they will normally have little or no formal education and their training will be confined to short courses, they will have to be guided and supported closely by their better educated superiors in technical and economic subjects. If the farmer extension workers are to be effective channels of two-way communication between the extension service and the farmers, the type of training and orientation they receive must seek to make them more curious about their total environment and must stress their responsibility for transmitting the farmers' reactions to extension programs.

Most tropical African countries suffer from a serious shortage of qualified agricultural personnel. We have already commented on the lack of staff for research. More generally, personnel shortages are most acute in the higher echelons of the agricultural service which have suffered from the enforced or voluntary resignations of expatriate officers since the advent of independence. The number of Africans in higher education who are receiving professional training in agriculture and related fields is still well below requirements. At an African conference on education held at Addis Ababa in 1961 it was reported, for example, that only 4.6 percent of the university students in 1961/62 were pursuing studies in veterinary science, agriculture and forestry.13 Makerere University College, which until rather recently was the only institution in Uganda, Kenya and Tanzania providing degrees in agriculture, produced only 65 agricultural graduates in the five years ending 1965.14 In Ghana, to cite an example from West Africa, the number of graduates has also been very small, and, as of the beginning of 1965 the number of profes-

14 This figure is taken from an informal working paper prepared for a working party established in Uganda to examine the policies, staffing, structure and methods of agricultural extension.
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sional and subprofessional staff actually serving in the public and quasi-public agricultural services amounted to only 23 percent and 40 percent of the total positions authorized.¹⁵

These shortages are not generally due to a lack of training and educational facilities. There are simply not enough people seeking careers in agriculture because other careers, particularly those in general government administration, appear more attractive. Although African governments may be able to influence this situation to some degree by emphasizing the critical importance of agriculture and improving conditions of service in agriculture, the shortage is likely to diminish significantly only as other, more appealing career opportunities become progressively less available. In the higher ranks it will certainly be possible to supplement staff to some extent by determined efforts to recruit people abroad on contracts that are sufficiently long and attractive to interest those with the requisite qualifications. We have already suggested the possibility of making contractual arrangements with foreign and international organizations who might be able to provide personnel of this type. Personnel recruited abroad is unlikely to be very effective, however, unless it is given adequate time and facilities to acquire a sufficient knowledge of local conditions and enabled thereafter to serve for a long enough period. Moreover, the recruitment of expatriates cannot be expected to compensate for any shortages of extension workers who deal directly with farmers and must be indigenous to the country.

It should be possible in any event to improve the training of those Africans who do seek careers in agriculture. Judging from our contacts with the personnel already working in agricultural field services, their training urgently requires reorientation and broadening. Although the quality of the extension personnel we encountered varied widely, we noted that the great majority showed serious deficiencies in their training not only in technical matters, but, above all, in the broader aspects of agricultural development that would enable them to diagnose the problems of their farmers and help determine some sort of effective approach to them. In most cases we found the knowledge of crop rotation, tools and implements, farm economics and farm management, and marketing to be seriously inadequate, and, in some cases, virtually nonexistent.¹⁶ Field per-

¹⁶ We are not suggesting that all institutions neglect these subjects. The Faculty of Agriculture at Makerere University College in Kampala, Uganda, has, for example, long been putting stress on farm economics and management. The deficiencies we have cited are particularly marked among subprofessional personnel.
sonnel usually have received little or no systematic instruction in extension methods, and where such training is now given it is often focused too much on means of communication rather than on a proper understanding of the social and economic factors that condition the acceptance of new practices.\textsuperscript{17}

If personnel is to be better trained in the future, one must start with the teachers themselves. They are often insufficiently aware of the practical context within which their teaching will need to be applied. Except, perhaps, in some of the more purely scientific subjects, they can hardly teach effectively unless they themselves have a good understanding of the whole environment—ecological, social and economic—within which extension agents will have to work. One of the difficulties is that the teachers, particularly those in institutions providing diploma- or degree-level training, are often foreigners who may have had little opportunity or inclination to familiarize themselves with local conditions. This condition has probably been aggravated by the recent tendency to engage such personnel on rather short-term contracts. Thus the teachers themselves must receive some orientation if there is not to be too great a divorce in agriculture between what is taught and what is practiced and if adequate attention is to be paid to concrete ways and means of applying the teaching. We noted in one particular case that a course on extension prepared by a foreign teacher put almost all of its emphasis on the means of getting the “extension message” across to the farmer. Apart from a token reference to the role of the extension worker in advising the government of the farmers’ needs for research, there was virtually no discussion of the necessity of understanding the indigenous farming systems and of devising a program with a substantive content that would meet the requirements of farmers and take into account their motivations and the limitations within which they work.

In every country it is important that knowledge of the principal variations in ecological conditions, farming patterns and social environment be systematically collected and reduced to writing. In Kenya the so-called “district gazetteers” which agricultural officers have compiled and amended over the years might be considered a step in this direction. Usually, however, these have been too technical in their orientation and content, although a few do reflect the authors’ interest in the broader context of agricultural development.

\textsuperscript{17} While suitable means of communication (including visual aids adjusted to the farmers' setting) are of course important, they are an effective supplement to other extension methods only if the content communicated meets the farmers' needs.
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In any event a systematic and comprehensive collection of this type of information and its periodic revision would be of tremendous assistance to both students and teachers. In addition the relevance of the training to the future work of the students could be considerably improved by sending them into the field once or several times to serve a period of apprenticeship to an extension agent, to conduct or participate in farm economic studies or undertake other specific tasks. Some institutions follow this practice to some extent, but it deserves to be made general. If such field work is properly carried out, it should not only benefit the student but also assist the teaching staff to obtain a better appreciation of the practical relevance of the instruction they impart.

Farmers' training institutions

We have had the opportunity to consider a few experiences with institutions established to give farmers more formal training supplementing the work of extension services. However, before discussing these, a few observations on the relationship of formal education to agricultural development may be hazarded. Much earlier in this study we noted that the need to earn income to defray the cost of children's education was acting as an incentive to farm development in some parts of Africa. The eagerness to educate their children which many parents in Africa display is undoubtedly motivated primarily by the hope of getting them away from the risks, drudgery and low income associated with traditional farming. The type of education is often held partly responsible for alienating children from their rural environment and contributing to the exodus to urban areas. Experts now generally agree that the content and methods of education, long modeled on Europe, need to be revised and related to the African context. They generally agree that former attempts to introduce a vocational agricultural bias in education at an early stage have been largely misguided and ineffective. At the same time it is considered important to alter the syllabus and methods of instruction so as to stimulate the pupil's powers of observation and sensitivity to his local environment and to identify the subject matter of instruction in language, arithmetic and natural sciences more closely with the pupil's surroundings.18 Wherever this

18 This view is well stated in the following quotation from The Report of the Uganda Education Commission 1963 (p. 16):

We do not believe that Agriculture as such is a suitable subject for primary schools, and we reject the idea that the study and practice of agriculture in schools will teach the children to believe in the dignity of manual work or in the importance of agriculture in the economy of Uganda. [cont. p. 188.]
view has been adopted as policy much usually remains to be done to define it in precise and practical detail and then to carry it out. It is obviously beyond our competence to enter into this subject. We only wish to point out that whatever is done to change the approach and content of general education, it is unlikely to have a significant effect on arresting migration to the cities unless attractive opportunities for commercial farming develop.

There is no doubt that formal education, which is still extremely limited over much of tropical Africa, can have a positive impact on agricultural development wherever farming can become a profitable business. School education does increase the readiness to innovate and enhances the incentive to earn more income. A man with some education can perceive more clearly the best of alternative ways of using the land and can participate more intelligently in the operation of cooperatives whose role in Africa is bound to expand. People with sufficient knowledge of arithmetic to keep even elementary accounts are often able to improve the management of their farms, and those with reading skills can readily take advantage of extension advice disseminated through leaflets, pamphlets and other written material. In Kenya, and particularly in the Central Province of that country, we encountered quite a few leading farmers who had some degree of schooling. It is noteworthy also that in Africa the educated man who takes up another occupation seldom loses interest in farming. He usually retains a stake in some land and may, in fact, as we observed previously, become a successful and progressive farmer on the side, provided he is close enough to his farm to give it effective supervision.

Vocational agricultural schools are usually justified only when agricultural development has reached a stage where commercial
farming offers opportunities for useful employment to graduates of such schools. In Kenya there seems to be an increasing number of farms both in the old African farming areas and in the new settlement areas on former European-owned land that could profit from the skills developed in a good vocational school. However, where a demand for vocational education does develop, this does not necessarily justify the establishment of special schools, particularly where this demand can initially be accommodated in existing institutions which have been wholly or primarily devoted to training agricultural personnel for the government services. There are apparently a few good vocational schools specializing in agriculture and rural crafts in tropical Africa, but in many cases the cost per pupil tends to be very high and the impact on rural development very limited.

Some attempts have also been made to organize practical training in farming for older boys who have had little or no formal schooling. One of the more interesting of these are the seasonal agricultural schools which have been established in Mali with financial support from the development fund of the Common Market. Each of these schools takes about 20 pupils ranging in age from 15 to 25 years and keeps them for one agricultural season so that they can learn to master all farming operations from land preparation to harvesting. Although there may be an hour of oral instruction per day and some lessons in literacy, virtually all of the training is practical, with the pupils doing all the work on the school farm under an instructor who usually is drawn from the extension service. The farming is in principle done in such a way as to illustrate, for example, the new methods and practices recommended by CFDT, including the use of certain implements, the production of manure, the application of insecticides and fertilizers, etc. The CFDT has, in fact, been given responsibility for some of the schools. Upon completion of their instruction the pupils were to be endowed with a pair of oxen and a plow and enabled to start farming on their own.

The concept of these seasonal schools seemed sound, and we noted that a few of them which were well located and well directed were

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19 The Kenya Government has decided to establish a number of special schools, the first of which was opened in June 1965, to train African farmers who want to buy large-scale farms from Europeans.

20 Among the more successful has been, according to reports, the Busoga Farm and Technical School in Uganda. This is a secondary school with facilities for giving 200 boys and 100 girls a three-year course combining academic education with practical instruction in agriculture, home economics and various crafts such as carpentry, plumbing, etc. A survey conducted a few years ago is said to have shown that 74 of 77 graduates had actually become involved in agricultural occupations. The cost is reported to be about £55 per student per annum, relatively high by African standards.
doing useful work. In practice, however, there have been many shortcomings. As is often the case in training institutions, the equipment and buildings of the schools were much more costly and elaborate than was required for the limited practical objectives to be achieved. There were far more implements than were needed or than the average farmer could be expected to afford and use. Some of the schools were badly sited and endowed with farm land so low in fertility that the crop yields achieved with improved methods did not compare favorably with those achieved in traditional farming. In some instances there was a failure to respect the need for keeping pupils throughout the whole season and for recruiting them from nearby areas where ecological conditions were the same as those of the school. Such errors in planning and execution can, of course, be avoided; and it seems to us that seasonal schools of this type can play a useful role in modernizing agriculture, provided the scale and cost are kept modest and the type and conditions of the farming they practice are not beyond the reach of the average farmer. Even then one must make sure that the farmers are really interested in getting this type of training for their sons and will give them land to farm when they have finished. In some of the seasonal schools in Mali the full complement of trainees had apparently been obtained only by putting considerable pressure on farmers. It was evident, too, that quite a few of the trainees did not expect to get land to cultivate, since it was customary, as almost everywhere in tropical Africa, for fathers to allot land to their sons only after they had married.

Farmers' training centers

For farmers themselves the most useful supplement to agricultural extension is likely to be the opportunity to participate in short-term courses which can be reconciled with regular farming. We had occasion to examine in particular the operations of the Farmers' Training Centers (FTC's) in Kenya, although we are aware that there are similar institutions operating in Uganda and Tanzania. We shall not attempt to duplicate here the description and analysis of these institutions given elsewhere in this report. We were impressed by the testimony—from farmers, staff and extension workers—to the constructive contribution which the FTC's are making in Kenya. At the end of 1963 there were 24 such Farmers' Training Centers with a capacity to accommodate nearly 1,300 people at a

21 See the Preface to the case studies on Kenya and the case study devoted to Nyeri District in Vol. 2.
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They give brief courses of one to two weeks to practicing farmers, both males and females. Their facilities are also used occasionally to give refresher courses to extension personnel and for special courses for cooperative and community development staff. Most of the farmers' courses are devoted to general agricultural and animal husbandry, but there are also a considerable number of brief special courses which may be devoted to particular crops such as coffee or tea or such subjects as poultry keeping. For the women there is always some instruction in home economics, which evidently not only appeals, but also helps make women's participation in courses more acceptable to the men. In 1963 over 4,000 women participated in courses as compared with about 9,500 men. Each FTC has a farm which can be used for demonstration work. The teaching is done by personnel of the agricultural field service which is detailed to the FTC's for designated periods.

Drawing largely on our observations in Kenya, we would venture the following conclusions about certain aspects or features of such training institutions:

1. The demand for training. Such a demand must obviously exist, and it is likely to emerge only after some development has taken place and people have been made aware of opportunities and the possible value of further training in taking advantage of them. In Sukumaland, we understand, the first institution of this type was closed because there were not sufficient farmers interested in attending; it should be noted, however, that a FTC recently established at Malya has aroused greater interest. In Kenya, where the demand for this training undoubtedly does exist, most of those attending the FTC's come from the more developed agricultural areas. In doubtful areas it is well to defer the establishment of permanent training facilities until demand is tested by running some pilot short courses at already existing institutions such as government experimental farms.

2. Location of training facilities. Wherever possible there should be a training institution for each ecological area. The usefulness of the training is impaired if the center must cater also to farmers from a different ecological area, particularly when none of the methods and practices related to crops in that area can be demonstrated on the center's farm or neighboring farms. Where, as in parts of Kenya, there are often sharp differences in ecological conditions within a small geographic area, it may not always be possible to meet this requirement.

3. The selection of trainees. In view of the role of women in agriculture it is important that women as well as men attend. The success
of Kenya's FTC's is in no small part due to the opportunity for training which they have given to women. Since, however, women generally do not have a determining voice in the adoption of new crops or new methods, the impact on farming is considerably enhanced if both man and wife (or wives) take the short courses, although they usually cannot both attend at the same time. In the interest of economizing transport and concentrating on people from identical environments, it is generally desirable to confine selection of participants in any given course to farmers from one area. It will often pay to have as many as possible from a single neighborhood participate so that they may help and support each other in subsequent attempts to apply what they have learned. Where there are, as in certain parts of Kenya, considerable differences among farmers in terms of the size and type of farm and of educational qualifications, it will be useful to keep the participants in any course as homogeneous as possible and to tailor the course to some extent to the problems and capabilities of the individuals. The smallholders and larger farmers in the Central Province of Kenya, for example, have quite different problems and requirements. If all participants in a course can read, write and do arithmetic, this opens up new possibilities with respect to both the curriculum and the methods of instruction. Such farmers can be given instruction in elementary farm accounting, a knowledge of which can often be instrumental in improving land use and farm management. It will be desirable also to select farmers who are likely to have some influence in propagating what they learn. Thus a special effort ought to be made to persuade members of cooperative committees to attend courses (apart from special courses on cooperatives) if, as we believe should be the case, the cooperatives are to become a more effective channel for promoting improvements in crop and animal husbandry.

4. Link between training institutions and the extension service. Kenya has stressed this necessary link by making the extension staff responsible for selection of the course participants and by drawing the directors and teachers of the FTC's from the agricultural service. Follow-up by extension workers is particularly important and appears to be often neglected in Kenya. In many cases the training centers are unable to teach and demonstrate new practices and improvements in such a way that the farmers can or will apply them on returning to their holdings. Usually the participants will leave with a disposition to try what they have learned, but they may find it difficult to put into practice unless they get additional advice or are enabled to obtain credit. The extension worker should utilize this period of enhanced receptivity to assist the farmers in working out problems of
application. This type of collaboration may be facilitated if at times the extension worker joins the farmers from his area in attending the course.

5. Staff training and conditions of service. While there should be a periodic exchange of personnel between the extension service and the training institutions, the experience in Kenya shows that some special provisions have to be made for staff assigned to training centers. In Kenya the lack of provision for some training in teaching methods has sometimes seriously impaired the effectiveness of instructors. If such training in pedagogy is to be given, it may well be desirable to keep the instructors at the training center for more than a few years before reassigning them to the field service. This makes it all the more necessary to make the conditions of service at training centers attractive. In Kenya the morale among some of the teaching staff was obviously low because inflexible bureaucratic regulations had made it impossible to adjust the pay of people assigned to the training centers in such a way as to compensate them for a heavier workload, higher housing costs and certain other disadvantages attendant on their assignment.

6. Concentration on training. The training center should not have other and ancillary functions which divert its attention from its responsibility for training. Considerations of false economy may burden it with various tasks which cannot be effectively discharged. In Kenya there has been a tendency to saddle the FTC's with the responsibility for operating rather large farms. These farms, whose management often takes about half the time of the teaching staff, serve only in part to demonstrate what is taught at the center. They are often expected also to conduct experiments, to propagate suitable seed varieties for distribution to farmers, and, above all, to earn income to cover part of the cost of operating the training center. All these tasks are seldom reconcilable, and it is doubtful in particular that the farms contribute significantly to the support of the centers.

7. Balance between classroom and practical work. A proper balance between these two is difficult to achieve. The very fact that the courses are short limits the opportunities and the scope for carrying out demonstrations and involving the participants in practical work. It is obviously impossible to take the participants through the whole range of farm operations during the season. The center's farm can and should be used, however, for practical training in whatever practices may prove pertinent, such as plowing and ridging, line sowing, interrow cultivation, pruning, spraying, fertilizer application, etc. For these purposes the center's farm need not be large, particularly since actual farms in the neighborhood can and should
also be used for demonstrations. It is unwise to use on the center's farm implements, machinery and methods which are clearly beyond the ability of farmers to adopt however attractive they might be in theory. At some FTC's in Kenya efforts have been made to include within the center's farm a "demonstration holding" that is supposed to illustrate what can be done with a peasant farm. This may well prove useful when the demonstration holding is rather typical, in terms of soils and size, of most of the farms served by the FTC. It is always difficult, however, to simulate convincingly the actual conditions of the farmer's milieu; and where, as in many parts of Kenya, there are many different types and sizes of holdings it becomes virtually impossible to illustrate the range of farming systems that might be feasible. Usually it will therefore be necessary to demonstrate the possibilities by visits to actual farm holdings in the area that have been significantly improved and illustrate the feasibility and profitability of various types of husbandry.

8. The curriculum. About the curriculum, few specific suggestions can be made since the subject matter must obviously be tailored to the knowledge and sophistication of the participants and the requirements as determined by the conditions in the area served by the training institution. The experience of Kenya illustrates the rather wide range of courses that can be given, as well as the possibility of providing special courses for extension staff, community development workers and employees of cooperatives. The differences in needs among countries and peoples are enormous. In the Chad we witnessed a number of farmers taking a two-day course in the employment and reading of scales which obviously interested them very much because it enabled them not only to weigh crops themselves but, above all, to check on the weights given by merchants and the possible methods of cheating on weights. In Kenya, on the other hand, we could see farmers taking a sophisticated course on animal husbandry, including the use of artificial insemination. There are some subjects, apart from specific problems of crop and animal husbandry, which require special attention. One of them relates to the use of tools and equipment which, as we have seen, is assuming increasing importance throughout Africa. Almost everywhere one is struck by the lack of knowledge of even the simplest problems of maintenance. In the Chad we noted that some hand-operated groundnut shellers were out of commission simply because farmers did not know that some bolts had become loose. In many places sprayers used on coffee, cotton and livestock had been discarded because of some simple defect which the farmer could easily be taught to detect and remedy. Farmers' training centers can play an important
role in demonstrating in simple ways how equipment operates, how it may go wrong and what can be done to make simple repairs or effect replacements of defective parts. Wherever possible farmers should also be given an opportunity to learn elementary farm accounting. In Kenya we encountered a number of farmers who kept simple accounts, including one who had gone so far as to keep a number of different crop accounts showing how much income had been derived from each crop in relation to the labor and cash expended. It was apparent that farmers learned a lot from such accounts, particularly about the comparative profitability of various ways of using their land and allocating their labor supplies. Obviously only a small percentage are as yet capable of, or interested in, keeping such accounts. But farmers' interest can be stimulated by simple demonstrations of the utility of farm accounts, and their capacity for keeping them is considerably enhanced by the fact that many farmers have children at home who have already had considerable education and who can help with such accounts. There is still another, and somewhat related need to give farmers at least some notion of the operations of the market and of the factors that determine prices. There is not only a widespread misunderstanding of the role of the trader, but also, as we have noted before, a dangerous and naive confidence that prices can and should be fixed by the "authorities."

9. Charges for attendance. It is a sound principle to charge farmers a daily fee for attendance at courses. The Kenya FTC's make a charge for room and board. The willingness to pay a fee is a test of the interest of the farmer and his determination to learn something.

**Evaluation of extension and training**

In most cases extension and training activities are carried on without any periodic and systematic evaluation of the results that are being achieved. Yet there is no field where there is a clearer need of such evaluation. There is a tendency to continue with the same approaches, the same methods, the same organization and the same personnel without determining how effective they have been and how they might be improved.

In Kenya a number of farm economic investigations have been carried out over recent years, and these can be considered an important first step in assessing the degree of progress made by farmers. They have pointed up the wide differences in the performance of farmers and have often cast a revealing light on the comparative profitability of various types of farming activities. Their purpose,
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however, has not been conceived broadly enough to make them satisfactory in evaluating extension work. Studies designed for this specific objective should be undertaken from time to time. This requires a survey of a representative sample of farmers to determine, through interviews and observations (1) what their yields and net output are, (2) to what extent they are carrying out extension recommendations and what factors appear to have prevented acceptance of such recommendations, and (3) if possible, what are the identifying characteristics of farmers who have responded to extension work and of those who have shown little or no response. Surveys of this sort can be useful in a number of ways. In some cases they can be very helpful in reorienting extension work toward those shown by experience to be most receptive. In other cases they can lead to a careful consideration of the specific difficulties which farmers have encountered in adopting extension advice, and the subsequent formulation of special measures to cope with such difficulties. This kind of evaluation obviously calls for more than a routine inquiry and requires considerable sophistication and judgment on the part of the investigators. It should be done by a group of well-trained people detached from the extension service whose work they will need to appraise.

Similarly, it is important to assess periodically the efficacy of the training given by institutions to extension workers and farmers. Generally the institutions that educate professional and sub-professional personnel for extension do not make or are not enabled to make a real effort to discover how their graduates are making out in the field and how relevant and useful they have found their education to be in coping with their problems. Extension workers should be encouraged to express their views on the relevance of their training, so that appropriate changes can be made in curriculum and teaching methods. The staff of farmers’ training institutions should also have some opportunity to determine what impact their teaching is actually having on the farm. In Kenya very few of the FTC directors and teachers have the time and the inclination to interrupt their work for brief forays in the field to see for themselves how former trainees are doing and to discuss with them as well as their advisers what difficulties are being encountered in applying the methods and practices taught at the centers. In the few cases where this has been done it was found that farmers were greatly encouraged by the continued interest displayed in them by FTC personnel.

It may, of course, be argued that evaluation requires more personnel, more time and more funds than are available. It may indeed be difficult to spare people from current duties to do this work or to
recruit or train the people who may need to be specially assigned to the job of evaluating extension work. In the end, however, proper emphasis on evaluation should result in more economical employment of scarce resources. At present far too large a proportion of the personnel and other resources devoted to extension and training is being wasted.
CHAPTER NINE

CREDIT, MARKETING AND COOPERATIVES

Credit

From interviews with African farmers one is often tempted to conclude that the shortage or unavailability of credit is one of the most important obstacles to agricultural development. However, a proper assessment of the role of credit is often difficult to make. The sorry record of repayment that characterizes the administration of agricultural credit in many countries indicates how difficult it is to establish an effective credit system. There are instances where liberal credit has obviously acted as a disincentive, an invitation or opportunity to the farmer to work less hard and to save less. At the same time one can also cite many cases where development efforts have been at least partly frustrated because farmers who were obviously trying to do their best did not have sufficient access to credit.

The need for credit

It is surprising how much development has taken place in tropical Africa with comparatively little or no credit. Most of the increase in output of cash crops has taken place in both East and West Africa without the infusion of large amounts of credit. In Kenya, for instance, much of the impressive development of African agriculture in the postwar period was self-financed. From 1948 to the end of 1964 gross issues of credit to African farmers from both government funds and commercial banks was probably no more than £1.1 million while the annual volume of agricultural output marketed rose by around £10 million. In Nyeri District we noted that coffee plantings were virtually all self-financed, and that coffee profits had in turn financed development of dairying. Similarly, in Elgeyo-Marakwet we encountered quite a few farmers in the uplands who had first earned some money from growing potatoes, had used this to start the cultivation of pyrethrum, and had finally purchased dairy cattle with their pyrethrum profits.¹ In Sukumaland very few of the

¹ See our case studies on Nyeri and Elgeyo-Marakwet Districts in Vol. 2.
thousands of plows which were instrumental in expanding cotton cultivation appeared to have been bought on credit. In West Africa the expansion of such tree crops as robusta coffee and cocoa has not been significantly assisted by credit.

Africans' disposition to save has often been underestimated. Even the migrant laborer often saves a surprisingly large proportion of his meager pay to take back or transmit to his native locality, and while most of this may eventually be devoted to "deferred consumption," it does illustrate that many people often do have some cash which can be devoted to productive purposes provided there is a sufficiently strong interest in, and opportunities for, development. In Kenya we encountered many instances where cash had been quickly mobilized for purposes in which people had a pronounced interest. For instance, a number of groups of farmers had raised money to buy rather large European-owned farms together. On the Mwea-Tebere irrigation scheme half of the nearly 1,250 farmers growing rice were reported to have bank accounts, and a thrift society licensed only in March 1964 already had £8,000 in deposits by July of that year. Experience shows that when cash income is increasing, savings can often be stimulated if opportunities are created through convenient postal savings facilities, thrift societies, mobile banks and similar means.

Initial savings for investment in agriculture may be generated in a number of ways. Where ecological conditions are favorable, where a profitable cash crop can be grown, and where enough land is available, the farmer often needs only a modest "investment" of family labor to get started and can subsequently use his first earnings to further expand his cash crop cultivation, often with the help of paid labor. In other cases the initial savings may be generated not on the farm, but from wages or from other occupations, including trade and handicrafts. A good system of agricultural credit must obviously seek to encourage and supplement these efforts and savings. This does not mean that farmers can or should invariably be expected to produce some savings as a condition for receiving credit. There are many farmers in the poorer agricultural regions who can hardly produce any margin above the barest subsistence income which they can utilize to take advantage of any opportunity to escape from the vicious circle of poverty. The farmers in the Bokoro area of the Chad are a case in point. There may be other farmers who though living in more favorable agricultural regions have barely

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2 The capacity of a crop such as cocoa to generate additional savings was shown by a sample survey of Nigerian cocoa farmers in 1951/52. In that year 40.6 percent of disposable income was on the average going into savings. See Galletti, Baldwin and Dina, *Nigerian Cocoa Farmers*, p. 462.
enough land for subsistence and cannot set aside any portion of their land for cash cropping unless they receive a credit to compensate for the temporary loss of income sustained until the crop matures. Many farmers with very small holdings in densely populated areas such as the Central Province in Kenya may fall in that category.

Thus, there are two types of farmers who may need credit: (1) those who have started developing their farms without credit but no longer find their savings adequate to defray rising development costs; and (2) those who have had little chance to acquire for themselves the resources required to escape from the bind of subsistence farming but have the opportunities and will to do so provided credit is made available. The first are likely to make the most productive use of credit provided their incentive to save is not impaired. The latter can be helped only at considerable risk because the potential for higher output is likely to be less certain and capacity for repayment correspondingly less. Extension of credit to this type of farmer must be undertaken if the fruits of development are to be widely shared, but it will need to be done in a more cautious and tentative way if serious losses are to be avoided.

Channels for credit extension

We have already commented on the need for an intimate link between agricultural extension and credit. The degree to which the extension service should get involved in the administration of credit will differ with the circumstances. Where in the earlier stages of development the extension service is responsible for supplying those requisites of production that are made available on credit, it will, in fact, be making the final decisions on loans, and even attending to their collection insofar as arrangements for the more or less automatic deduction of repayments from the market proceeds of crops fall within its responsibility. Generally, however, experience indicates that the usefulness of an extension service, and the efficiency of credit administration, will both be impaired if the extension service is made responsible for loan decisions, loan accounts, and loan collection. These are tasks that can be much better handled by a special credit institution.³ The latter, however, cannot be expected

³ Collection poses a special problem. Unless the number of loan accounts in any locality is so large as to warrant the employment of full-time staff to collect payments directly from farmers, the task of collection may have to be entrusted to personnel in the general government administration, but under the direction and with the prodding of the local representative of the credit institution who is responsible for keeping loan accounts up to date. This is the current situation, for example, in Kenya.
to have a far-flung and numerous field staff, or to make judgments which only agricultural extension workers in close touch with the farmers can make. Only extension personnel can advise the credit agency on the needs of the farmer and his capacity to utilize credit effectively. In most cases the extension service will also be unable to escape some responsibility for ensuring that the loan is in fact disbursed for the purposes for which it was granted. Above all, credit should be used to help farmers adopt the innovations and improvements that the extension service is seeking to promote.

1. The role of commercial banks. Autonomous government credit institutions, working closely with the agricultural extension service, are likely to be the best means for financing farm development. Under the conditions existing today in most of tropical Africa, commercial banks are not generally very suitable and promising institutions for extending credit to individual African farmers. It was hoped that Kenya's commercial banks would become important sources of credit once titles to land had been issued and it became possible to secure loans by mortgages on the land. Commercial banks have indeed extended a considerable volume of credit to African farmers, but they have not found this business really profitable and have shown a tendency to contract their lending. In practice, mortgages have not proved a very effective security. Discussions with commercial bankers in Kenya who have lent considerable amounts to African farmers on mortgages have impressed on us that procedures for realizing on such security are time-consuming and costly, and that in the last analysis it is difficult, if not impossible, to sell land when a court judgment has been obtained, owing to the widespread popular antagonism to the foreclosure of mortgages. True, fear of the possible loss of land, particularly among the unsophisticated, is sometimes a spur to prompt repayment. Basically, however, the creditor must rely on the integrity of the borrower and the effectiveness of the credit in providing the extra farm income out of which loans can readily be serviced. The bad experiences which banks in Kenya have had in securing loan repayments have made them very cautious in extending additional credit and led them to reduce the maturity of their credits to extremely short periods. They have tended to confine their lending to people who have a regular source of nonagricultural income or who can pledge income they regularly receive through a cooperative for deliveries of such products as coffee or milk. Commercial banks also are not particularly well equipped to assess credit needs of a large number of small farmers, or to control the disbursement of loans in such a way as to ensure that expenditures are really productive. This does not mean, of
course, that commercial banks cannot play a useful role in financing a limited number of the larger commercial farmers or some of the operations of cooperatives; and they might also extend credit to cooperatives for relending to individual member farmers.

2. Credit through cooperatives. We are persuaded that cooperatives should progressively be "geared into" credit administration as soon as they show the capacity to do so. As long as a government institution is the sole means of channeling credit to thousands of individual farmers, there is not only the danger of excessive bureaucracy, centralization, and complicated procedures, but, above all, the risk that the credit recipient will look upon credit as simply another form of government largesse and will, therefore, feel little responsibility for repayment. We noted that in a number of Kenya cases the responsibility for collecting payments on a variety of loans made to African settlers on former European farms was being successfully transferred to cooperatives of settlers. In principle, cooperatives should be able to judge not only the personal "creditworthiness" of loan applicants, but also, in view of their control over the marketing of principal crops, to ensure the service of loans. In parts of Uganda, Tanzania, and Kenya cooperatives have reached a stage of development where their ability to handle government or other funds for re-lending should be tested. Admittedly there are dangers in such a course, particularly favoritism in loan administration or inefficiency in handling loans. There obviously must be safeguards and conditions. Special training of staff in loan administration work will undoubtedly be necessary. To ensure that cooperative management will have a real incentive to obtain repayment, it may be desirable to require some matching by the cooperative of the borrowed funds, be they from government or commercial banks. The cooperative may also be required to insist that the ultimate borrower furnish additional surety either by having his loan cosigned by other farmers, or by joining a special mutual credit society whose members will guarantee repayment at least up to the limit of their contribution to the share capital. Such special security arrangements may even be necessary where the lending cooperative handles the marketing of the borrower's crops, for experience shows that repayment can be evaded by such means as delivering farm produce to the cooperative through other farmers.

Whether the government extension service should continue to play an advisory role when credit is extended through cooperatives will not be easy to determine. There should be no need for such a role in the case of seasonal agricultural credit. On proposed loans for farm development it would probably be desirable to seek the
views of the extension service, at least until the cooperative acquires the necessary staff and experience to screen applications by itself. In the long run, however, cooperatives should be enabled to assume undivided responsibility for handling credit subject only to review by institutions on which they must depend at least in part for their loan funds.

There may be occasions when it is desirable to channel credit through a cooperative even when its members are not yet capable of managing the cooperative with reasonable efficiency. In Upper Volta, for example, we noted that cooperatives were being used for this purpose, even though the agricultural extension organization—SATÉC in this case—had to assume virtually complete responsibility for their management in view of the illiteracy of their members. The farmers were persuaded to contribute share capital to their cooperatives for the sole purpose of depositing all of this capital as a fund to guarantee repayment of loans to individual members for the purchase of draft animals, cultivators, and fertilizers. Such an arrangement can work provided that (1) it is part of a wider program to use cooperatives for introducing improvements into agriculture, (2) the cooperatives are likely to remain under effective supervision as long as necessary, and (3) the members understand the nature of the guarantee. In Upper Volta it was not entirely clear that the farmers did indeed understand how the guarantee was supposed to operate, for they appeared to think that it could be made inoperative by expelling a defaulting member from the cooperative. One other prerequisite should be mentioned—namely, that a cooperative which assumes a collective responsibility for loan repayment should be kept small enough so that its members can be expected to know each other well enough to assess the risk they are taking. This applies also in the context of the preceding paragraph.

Types and purposes of credit

Determination of the purposes for which credit can or should be extended is obviously of critical importance. We have stressed the importance of using credit to support and not to replace the effort which the farmer can make to save and work. It follows from this that credit should be extended only to cover outlays which are significant in relation to the farmer's resources and thus, presumably, cannot be financed out of any efforts or savings he could be expected to make. Depending on the circumstances, this may have practical implications for different types of loans. Let us first take so-called "crop establishment" loans. The conditions under which such loans are necessary on already established farms are likely to be rare.
Once the profitability of such perennial crops as coffee, cocoa, tea, etc., has been established, farmers should usually be able to meet the rather modest cost of planting material, and to furnish the labor required for land preparation and planting. The exception might be the small farmer who has had no opportunity to save and needs assistance, as we have indicated, to emerge from subsistence farming. Crop-establishment loans may also be given to settlers on new farms, but here, too, there is a danger of abuse. In Kenya loans given to pay for such tasks as plowing and planting on settlements carved out of former European-owned farms have often freed settlers from work they could clearly do themselves; and the terms have been excessively generous in that repayment was extended over five years and often began only after two crops were harvested.

Short-term loans to cover the cost of recurring seasonal production requisites such as fertilizers and insecticides appear justified to encourage and facilitate the more general use of such supplies, always provided that their employment can be demonstrated to be regularly profitable to the farmer. The issue of seasonal supplies on credit year after year is likely to be feasible only if the cooperative or other organization responsible for the issue has the facilities for automatically recovering credits from the proceeds of marketing the borrower’s crops. In any event, once farmers are convinced that the use of fertilizers and insecticides does pay, the possibility of buying them on credit is likely to be less important than reliable arrangements to ensure their supply in the right amount and at the right time.

We have emphasized that labor bottlenecks at certain times of the year are often responsible for failure to adopt new crops or practices. In principle it would seem to be as justifiable to finance outlays on labor required to increase production as to accord credit for the purchase of implements and machinery. We encountered many farmers who claimed that credit for this purpose would be very helpful. There are, however, serious practical difficulties. It is hardly possible to exercise adequate control over disbursement of credits for wages. As we have pointed out, it is often difficult to distinguish between employment of labor as a means of raising output and the use of wage labor to "purchase" additional leisure for the farm family. In general it would be unwise to give credit for wages unless extension workers are sufficiently sophisticated and objective to single out those farmers who are making full use of family labor resources and could definitely be enabled to overcome a bottleneck and achieve a higher output if they were able to pay wage labor. Even under these circumstances there would be no justification for continued
financing of wage outlays after the higher level of output is attained and the farmer can accordingly use a portion of his production increment to pay for essential labor himself.

Credit is often necessary to finance implements and machinery or other investment outlays. While farmers can frequently pay cash for a rather inexpensive ox plow, they usually need credit to buy a set of ox drawn implements, a cart, a sprayer and, of course, a tractor. Since the average farmer cannot make full use of a tractor, and even of such items as a cart or sprayer, cooperative acquisition and ownership may need to be encouraged. Such cooperative groups should be kept as small as possible so that the members have full confidence in each other and are willing to be individually as well as collectively responsible for the payment of any loans they may contract for equipment.

One of the more controversial issues is whether credit should be available for the transfer of means of production from one farmer to another. This arises concretely in the case of draft animals, and also in the case of land where the latter has become marketable. In Mali we found that the extension of credit for the purchase of draft oxen had been stopped not only owing to a shortage of funds and difficulties of repayment, but also on the assumption that under the extensive kinship ties prevailing among the farmers those who had no oxen could somehow get some for whatever plowing had to be done. In Kenya land is made available in new settlement areas on generous credit terms, but within the established African farming areas it is impossible to get credit to purchase a farm even when otherwise there is no bar to such a transaction.4 We believe credit should be available to finance such transfers of productive resources whenever this can contribute to a rise in output. Elsewhere we have remarked on the wide differences in enterprise and performance among farmers. A transfer of assets to those who can use them more effectively can often make an important contribution to output. We have already pointed out that in Kenya farmers who had purchased their land often had a much greater interest in developing it. In addition, we found areas where farmers who had taken up larger holdings on settlement schemes had left their old farms to less efficient caretakers simply because other farmers capable of making better use of the land did not have the financial resources to buy these farms. As for draft animals, they were usually poorly distributed, with many farmers having few or none apparently through no fault of their own.

4 Under the new 1966-70 Development Plan, however, credit is to be made available for this purpose.
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In Mali and elsewhere it was by no means easy for farmers without draft oxen to get access to such animals through their kinship ties. While oxen can at times be hired or borrowed, this can often be done only at the expense of early planting. We are not suggesting, however, that credit to finance transfers of productive assets should be made easy. There must be reasonable showing that the purchaser will use the assets productively, and the purchaser should acquire an immediate personal stake in the transaction by being required to put up a significant part of the necessary funds, particularly in the case of land transactions.

The repayment problem

Repayment of credit has been a serious problem in most places. We have already commented on the relative efficiency of various devices to secure repayment, such as mortgages, joint liability, and automatic withholding from market proceeds. Cheap and excessively generous credit tends to be harmful. Experience indicates that the cost of credit should be constantly brought home to the farmer so that he will not assume a debt burden frivolously. The period of repayment should obviously be geared as closely as possible to the anticipated rise in the farmer’s income that is expected to result from the loan; and the failure to respect this requirement has in the past often resulted in defaults. It has frequently been said that in the last analysis repayments can be obtained only by ensuring that the loan really results in an adequate increase in output. That this is in the long run an essential condition of repayment can hardly be challenged. However, we encountered many cases where farmers obviously could pay but were not doing so because experience had led them to believe that defaults would be tolerated. We found, for instance, that the Nyeri District had had one of the worst repayment records in Kenya even though agriculture had made impressive progress. Efforts were being made to improve the hitherto lax loan administration, and particularly to institute more vigorous collection procedures, but although some success was being achieved, it seemed likely to take some time before farmers could be persuaded to respect the sanctity of their obligations. On the other hand, we found that the Mossi farmers in the central region of Upper Volta were still sufficiently “unspoiled” as to take their loan obligations seriously. Not only were they very reluctant to assume debt for fear

\[5\] However, this has not prevented a deterioration in credit payments since farmers simply have not had sufficient cash income. See our case study in Vol. 2, “Upper Volta: The Agricultural Extension Program of Société d’aide technique et de coopération in the Mossi Country.”

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they might be unable to repay, but they were tapping every resource to repay those they had contracted, even though the credits had apparently not produced a significant increase in their marketed output. It is one of the elementary lessons of experience that credit cannot be developed on a sound basis unless from the beginning there is strict insistence on repayment.

**Marketing: some observations**

Market limitations undoubtedly hamper the development of African agriculture. In the past, production for the market has been primarily oriented toward exports. Yet world markets are highly competitive, and world consumption of most of the commodities Africa produces is growing rather slowly. As indicated at the beginning of this study, we have excluded any analysis of the growth of external demand from our terms of reference. It may be appropriate, however, to make one general observation regarding the place of tropical Africa in the world market as distinguished from the African market. One should not underestimate the possibility of capturing a growing share of this market, even though demand as a whole is expanding at only a slow rate. For many products African farmers enjoy an advantageous competitive position. The fact that yields in African agriculture are generally not high often leads to the erroneous conclusion that Africans may be unable to withstand keen competition. As a matter of fact, African producers of such products as coffee, tea, cotton, and vegetable oils are for the most part likely to hold, or even strengthen, their position in a period of declining prices. Fixed costs are but a small part of their total costs, and their "opportunity costs" of production are low—that is, they can continue to produce at a low price because there are so few alternative opportunities for the employment of their labor and land. True, there are African farmers who will be discouraged by declining prices, but the growing proportion who have become accustomed to the enjoyment of cash income will tend to keep up, and even expand, their output.

**Development of African markets**

In the future it will be necessary, however, to explore more intensively the possibilities of cultivating home markets through purely domestic and intra-African trade. This necessitates development not only of urban African markets, but also of the markets which farmers could create through greater specialization of production and exchange of produce among themselves. In a continent so largely devoted to agriculture it is ironical that so much of the growing demand
for food in African cities has been met by imports, from non-African sources, of such items as wheat flour and rice, as well as many types of canned and processed foodstuffs. Part of these imports are due to the persistence of substantial European communities in the cities and the development of “European” tastes by Africans. In part, however, African urban consumers, including the large proportion of urban labor migrants, appear to prefer foreign foodstuffs because they are convenient and require little or no preparation. There is probably a need to explore how the traditional African foodstuffs can be made more attractive to the urban consumer through improvements in storage and transport, and, above all, through new and better methods of processing. The possibilities of specialization and exchange among African countries, particularly those that can be closely linked by transport, must be carefully examined. A case in point is the development of rice production and trade in West Africa. Rice is an important staple in that part of Africa; many areas grow rice, but they have obviously had difficulty competing with the rising tide of imports. Even a cursory survey of the various rice-producing schemes and areas in West Africa points to the importance of a thorough regional study to determine the best methods of raising output and selecting the areas that are likely to have the greatest comparative advantage in producing more rice.

At present the domestic markets for food in tropical Africa are very thin. This is partly due to the still limited degree of urbanization so that opportunities for exchange between country and city tend to be restricted. But it is also due to the fact that trade among farmers themselves is so small. As long as each farm family insists on producing its own food, the market supply will largely consist of adventitious surpluses, and demand of equally adventitious deficiencies. Since surpluses and deficiencies are primarily determined by climatic factors, they seldom coincide in point of time. Under these circumstances prices can fluctuate very widely. Small additions to the supply may bring about a sharp drop in prices. Often the quantity of produce brought to rural markets is so small that prices even in markets rather close to each other may diverge widely simply because it does not pay traders to engage in arbitrage. Farmers tend to become involved in a vicious circle, since the unreliability of the market encourages continued farm self-sufficiency and the persistence of the latter makes it impossible to develop a large and stable market.
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Specialization of production and trade among farmers

Here and there some specialization among farmers has developed. Thus, on the slopes of Mount Kilimanjaro in Tanzania some farmers are producing milk for sale to coffee farmers in the same area, and Gisu coffee planters on Mount Elgon in Uganda to some extent buy grain from farmers down in the plains. In the Central Province of Kenya we noted that some farmers were giving up the production of maize in order to concentrate on the development of dairying and cash crops. In West Africa farmers producing robusta coffee and cocoa often buy a significant portion of their food consumption in the market. In some countries with widely differing ecological zones there has also been a growing volume of interregional trade in foodstuffs, although this has usually been confined to items supplementary to the food staples which constitute the basic production and consumption in each zone.

On the whole, however, both policy and practice have tried to reconcile production for the market with continued farm self-sufficiency. This has limited production potentials by preventing specialization in the growing of the principal foodstuffs consumed by the population. These consequences are particularly striking in a country with considerable ecological diversity such as Kenya. Virtually every farm tends to grow its own requirements of maize (or in some cases sorghum) despite the fact that the “opportunity cost” of producing it varies widely. Areas that are not suitable for the production of cash crops for export such as coffee, tea, pyrethrum, etc., tend to be doomed to a low level of subsistence because there is no domestic market for their produce. The same is true of the numerous small farmers who have little or no land to spare for cash crops after meeting subsistence requirements. The development of trade or exchange among farmers would not only raise incomes through specialization; it might also, in the end, help to bring about a much-

7 According to Galetti, Baldwin and Dina (Nigerian Cocoa Farmers, pp. 489 and 598), Yoruba cocoa farmers covered in a 1951/52 survey were purchasing as much as 68 percent of their food requirements. In a few other instances, such as among the farmers of southern Dahomey, a high degree of dependence on the market can also be noted. In these cases food purchases apparently do not result so much from a curtailment of food production as from a habit of selling a large part of the food crops immediately after the harvest and meeting subsequent requirements in the market. The development of this practice seems to have resulted largely from the progressive tendency of the women to specialize in trade. Whatever have been the causes, the practice does appear to indicate the possibility of developing confidence in the ability of the market to discharge its function of storing commodities and equilibrating supply and demand over the year.
needed diversification and improvement in diet. One of the important functions of agricultural and market policy should be to assist families in developing some degree of specialization.

It must be conceded, of course, that such specialization can only come about gradually. The extent to which it should be officially encouraged will depend on the stage of development to which people have already attained, on the remoteness of particular areas and the state of communications and on the differences among farmers within the same area. We would hardly recommend specialization for remote areas or for societies which have as yet experienced little development or contact with the market. In such areas farmers are most strongly attached to security, and the ability to satisfy the farm family's own food requirements is a key element in that security. Transport costs may put an excessive burden on much of what they can sell or buy. Under such conditions initial development efforts must be reconciled with continued food self-sufficiency, and may even be more attractive if they reinforce the security of the food supply. The attraction of such early development projects as the Gezira scheme, for example, was due not simply because it enabled farmers to earn cash from cotton growing, but because it afforded an opportunity to keep the livestock and produce the sorghum on which the food supply depended. There are still societies in Africa in which inability to supply one's own food is considered a blow to one's prestige and standing.\(^8\)

Where there has been considerable development, as in large areas of Kenya, more emphasis might well be placed on specialization. Even here, of course, there are many cultivators who are primarily subsistence farmers and have insufficient land. Such farmers would be more effectively assisted, at least initially, by a program that would show them how to raise their food requirements on a smaller area, thus releasing some land for cash cropping. However, those farmers who have already developed market crops and have a cash income that enables them to take some risk, should be encouraged gradually to specialize more, and to buy more of their food requirements from other farmers, including, perhaps, the smaller farmers in their neighborhood whom we have just mentioned. The specific measures to accomplish this objective will not be easy to devise. We would suggest the following for consideration:

\(^8\) The Tonga are said to consider that people who grow grain for sale to their fellow men exploit the latter's misfortune, and that those who are incapable of supplying their own are especially unfortunate. (See Elizabeth Colson, "Trade and Wealth Among the Tonga," in Bohannan and Dalton, editors, *African Markets.* We noted a somewhat similar feeling among the Mossi of Upper Volta and the Bambara of Mali.

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1. The possibilities for specialization and trade both among various ecological areas and even within such areas should be systematically explored. In Kenya, for instance, the Tugen Hills of Baringo District might be in a good position to produce seed potatoes free of bacterial wilt for planting in other areas of Kenya. Some of the South Baringo plains might specialize in maize, provided effective action can be taken against the maize stem borer, and good yielding, short-maturing varieties can be grown. Portions of Central Nyanza, Machakos and Kitui Districts might be well situated to concentrate on cotton or groundnuts. Within the Central Province a division of labor between producers of potatoes and vegetables, and farmers engaged in producing milk, might be explored. All these, however, are not recommendations, but only illustrations of possibilities that may merit further investigation. In exploring such possibilities it should be reiterated that a particular area should not necessarily specialize in those crops in which it can achieve the highest yields in the country, but rather in those in which it excels in relation to alternative opportunities within its own area.

2. Extension workers and the staff of farmers' training institutions should be made more aware of the alternatives to subsistence crops and should in turn make farmers conscious of these possibilities. In the Nyeri District of Kenya, where commercial farming is devoted to dairying, coffee, and tea, we found few agricultural field staff and farmers aware of the cost of growing poor-yielding food crops in terms of the alternative uses of the land. This is an important part of farm economics which, as we have repeatedly indicated, should receive more attention.

3. Efforts must be made to ensure the woman an adequate and regular share in the farm’s cash income. Wherever women have the responsibility for feeding their families and have little more than the pittance in cash which they derive from selling occasional surpluses or from activities for which they are traditionally responsible, there will be strong resistance to greater reliance on the market for essential foodstuffs. Once such women can dispose of a larger share of the family’s income, and they are given some knowledge of nutrition, through farmers’ training institutions and other means, the possibilities of spending more income on food and on types of food that may improve the diet are likely to be enhanced. The gradual achievement of these objectives will require measures of political education directed at the men as well as the women, social work among the women, and other steps calculated to give women a status of greater equality with men.

4. Special measures may be necessary to improve communications. The
lack of all-weather roads may not be a serious handicap when farmers are self-sufficient in food and need roads only in the dry season to market their crops following the harvest. All-weather roads become vital when people must regularly buy a significant portion of their food requirements throughout the season and when they derive almost all of their income from such crops as tea or sugar which must be harvested and marketed more or less continuously.

5. In the field of marketing organization various steps may need to be taken, depending on the situation. Where, as in many countries, public or quasi-public marketing organizations offer identical prices throughout the country in buying produce, it may be necessary to consider whether these buying policies, which are designed to increase the opportunities of more remote parts of the country to share in income from cash crops, do not unduly interfere with specialization based on comparative advantage. Cooperatives and other marketing organizations which have been collecting produce for sale in urban and export markets must be encouraged to pay more attention to the development of local outlets. In Kenya, for example, we found quite a few local dairy cooperatives that were neglecting the possibilities of local sales and were trying to penalize their members who were selling in the local market. In quite a few countries cooperative and state marketing organizations are too intent on achieving and maintaining a monopoly of purchase and trade and on concentrating on urban and export markets. Such monopolies are often inefficient, producing an excessive disparity in buying and selling prices and preventing the development of local trade and markets. To be sure, both producers and consumers of foodstuffs in the rural areas must develop confidence in the stability of the market. It should suffice, however, to have a marketing organization ensure the producer a floor price and to use stocks purchased at this level primarily for the purpose of supplementing private trade supplies to “importing” areas so as to enforce a ceiling on prices. It is desirable, on the one hand, to capitalize on the inherent advantages of private trade which, with competition and without high overhead costs, is likely to operate on small margins, and, on the other hand, to have the minimum state intervention in marketing that is necessary to protect producers and consumers against possible abuses by private trade and against the consequences of adventitious fluctuations in harvests from year to year.

A policy of encouraging specialization and trade, no matter how discriminatingly applied, is apt to be attended with risks. There are always the dangers of mono-culture, of excessive dependence on the market of one or a few crops which may experience a sharp drop in
price. Food harvest failures may result in short supplies and exorbitant prices for those dependent on the purchase of food. There is also the danger that farmers who become more dependent on the market will spend their income unwisely and may buy the type of cheap foodstuffs which will depress rather than improve nutritional standards.\textsuperscript{9} Risks, however, are inherent in development. They can be anticipated and reduced by timely measures, but they can seldom be altogether avoided. The potential of tropical African agriculture can hardly be realized unless African countries go through more or less the same economic evolution as the more advanced countries, where there is not only an active exchange between town and country, but where farmers are each other's customers to a significant extent.

\textit{The role of cooperatives}

We have already had numerous occasions to refer to the role of cooperatives. The history of cooperative action in tropical Africa has witnessed many failures as well as some successes. Without doubt cooperatives express the social, economic, and political philosophies which inspire many African leaders; and African governments are and will be determined to assign to them an increasingly important and expanding role. Experience shows that they can be a vital means of evoking among farmers a sense of participation and responsibility—in marketing and processing farm products, in supplying requisites of production, in effecting improvements in crop and animal husbandry and in administering credit. But it is important to understand the conditions for success, their limitations and deficiencies as well as their potentialities.

True cooperatives, in the sense of organizations which are managed by the members and with which members really identify themselves, are likely to develop only in areas that have experienced considerable development and have at least some reservoir of educated people capable of looking after cooperative affairs. However, cooperatives have been repeatedly started where these conditions are not fulfilled and where they in essence have to be run by the agricultural extension service or some other government agency. Such cooperative groups may still play a useful role, provided that they are confined to certain functions and that the government service under whose tutelage they come makes a special effort to give

\textsuperscript{9}This has been true to some extent, for instance, of Nigerian cocoa farmers. See in this connection William O. Jones, "Environment, Technical Knowledge, and Economic Development in Tropical Africa," \textit{Food Research Institute Studies}, Vol. V, No. 2, 1965, p. 110.
the members a gradually increasing understanding of the operations and a sense of identity with the group.

We have seen how cooperative groups of this sort can be usefully employed to buy and test new implements, to join together in trying out new crops and new practices, or to pool land for facilitating agricultural operations. The cooperative grouping of farmers for these purposes need not always become legal in form unless some contractual obligation such as a loan for the acquisition of equipment must be undertaken. Moreover, they can often be disbanded after they have demonstrated methods and practices which individual farmers can and even eventually prefer to carry out on their own.

In general it is inadvisable to have such cooperatives take on functions for which members are unlikely to assume any significant responsibility for the foreseeable future. In the Bokoro area of the Chad, for example, the BDPA undoubtedly managed to get a favorable reception among farmers by establishing cooperatives which, under its management, produced some immediate and substantial benefits through the cooperative sale of groundnuts and millet and the purchase of a few prime consumer necessities. However, in view of the illiteracy of the rural population, it seemed doubtful to us that such activities could be successfully continued once external management or close supervision was withdrawn. In Mali, too, we found that the Government was really managing the village cooperatives to which every family was required to belong and which were trading in consumer goods as well as farmers production requisites. In this case, however, there appeared to be some justification for using "cooperatives" of this type as channels for the distribution of supplies required for production, since private trade was generally not equipped to handle this business. The same justification could hardly be urged for the supply of staple consumer goods which are bought in sufficient volume and which can often be handled more efficiently and at lower cost by private trade.

Cooperatives and kinship

The relationship of cooperatives to the traditional kinship system sometimes raises difficulties, particularly in terms of who should or should not belong. It has often been argued that the kinship group and the modern cooperative are quite different in purpose—that the kinship unit is designed to provide in essence some form of social insurance through reciprocal obligations, to apportion output among its members but not to increase it, whereas the modern cooperative is concerned with raising the standard of living of its members and their bargaining power with "outsiders." Whatever
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may be the merits of this argument in theory, there may well be, in actual practice, a close and even unavoidable connection between kinship groups and cooperatives, especially in the initial stages of cooperative development. This is particularly true where specific lineages live in defined locations instead of being mingled with other lineage groups. Among the Gisu in Mount Elgon, for example, membership of the primary coffee societies and the minimal lineages of the villages have been identical; and in the Chad and Upper Volta the cooperative groups we saw appeared to be based on kinship ties. In fact, where kinship groups are still very strong and are not rent by internal strife they may form the best basis for cooperative action in the beginning. This seemed to be true of those in the Chad and Upper Volta and of those who have had some success in undertaking group farming. It must not be assumed, however, that kin-based cooperatives should be led by kinship elders. More effective leadership is likely to be provided, as we found in Central Nyanza, by younger and more progressive elements. Moreover, there is little doubt that in the end cooperatives should transcend kinship ties. Experience indicates that there is always a danger that kin-based cooperatives will be too easy on their members, particularly in the enforcement of standards of quality for the products they process and market. This we noted to be particularly true of the kin-based coffee cooperatives in Bugisu District of Uganda.

*The problem of size*

It is usually desirable to keep primary cooperative societies or groups as small as is compatible with their objectives. If at all possible they should be small enough to enable members to acquire confidence in, and knowledge of, one another and to achieve a sense of personal participation in the cooperative action. We have already indicated that this is particularly important for groups that are designed to support each other in carrying out certain innovations in agriculture, to test or own agricultural equipment in common or to provide a collective guaranty for credits. The size of cooperatives will, of course, also depend on their functions and the availability of staff. Cooperatives that have the fairly simple task of collecting, grading, storing and then selling products or delivering them for processing can be kept rather small. This is true, for example, of the cotton, dairy and pyrethrum societies we saw in East Africa. On the other hand, when the primary society, rather than a union of primary societies, is expected to operate a coffee factory or a cotton ginnery it must obviously be much larger. It will usually take at least 100 acres of coffee planted by perhaps 100 to 250 farmers to
support a coffee factory of minimum size. A cotton ginnery may require a minimum supply of six million pounds of raw cotton, and since that would entail a membership of thousands of farmers, it would be preferable to have a union establish such a ginnery. The need for a minimum of trained staff might also militate against small cooperatives. However, where unions have been formed these can often be equipped to maintain a reservoir of trained people to help the small societies administer their affairs.

**Delimitation of functions**

Proper delimitation of the cooperatives' activities tends to be a continuing problem. We have already commented on a range of functions which cooperatives have been discharging under various conditions. Only a few supplementary observations are in order. We have suggested that cooperative ranching may provide a way of dealing with problems to which neither government grazing schemes nor individual enclosure of ranch land has provided effective answers. On the other hand, we have expressed our doubts about cooperative farming unless, as has sometimes happened in Kenya, the cooperative is only a thinly disguised limited liability company whose "stockholders" appoint a manager to operate the farm. There is still the question, however, whether cooperatives or informal cooperative groups should undertake responsibility for performing certain tasks on their members' farms. Where members have pooled or rearranged their land holdings, they can no doubt often carry out certain operations like land preparation and spraying more effectively as a group, and at the same time retain individual family responsibility for other essential operations. However, if cooperatives attempt to carry out work on scattered individual holdings, they are much less likely to be successful, particularly when the quality of work is critically important. Some coffee cooperatives do have teams to do pruning and spraying. Sometimes this has resulted in a temporary improvement of crop husbandry, but there is always a temptation for farmers to let too much of their work be done by others; and in the end these tasks are likely to be carried out more efficiently if the individual farmers who have a direct interest in the quality of the work are taught and equipped to assume the responsibility themselves.

The functions that cooperatives have generally shown a capacity to handle are the buying, bulking, grading, storage and simple processing of farm products. Once they handle such operations with some success there is always a strong temptation to take on functions which involve excessively complicated management or which can
be discharged with equal or greater efficiency by others. In Tanzania, for example, it seemed to us that the Victoria Federation of Cooperative Unions, which undoubtedly has a record of impressive accomplishments in some respects, had rapidly assumed a crushing responsibility for a wide variety of tasks including the management of ginneries, rice mills, sisal factories, the purchase and sale of fertilizers, the administration of credit, the operation of a large fleet of tractors, etc. Such rapid expansion can easily produce inefficiency. Moreover, it can produce a bureaucracy with a quasi-independent management which is no longer responsive to the rank and file members and from which the latter feel alienated. This danger may become particularly acute with the development of a pyramidal organizational structure of several layers including not only primary societies and unions, but also regional and national federations of unions.

The relationship of cooperatives to private trade poses a difficult problem. The dominant motive for founding cooperatives is usually to combat the “exploitation” of the farmer by the trader, and this motive tends to be all the more appealing if the trader is an alien—a European, an Asiatic (as in East Africa), a “Syrian” (as in West Africa), or even members of other African tribes. Farmers are obviously justified in trying to do what they can to improve their position in the market, particularly by strengthening their bargaining power vis-à-vis private traders. It is more doubtful, however, whether it is in their own interest to have cooperatives replace private trade by insisting on a monopolistic position. When a cooperative is struggling to get established there may be some justification in protecting it against unscrupulous competition by private traders who are bent on its destruction. However, to accord cooperatives a permanent monopoly may simply invite inefficiency, particularly since its members often do not have the necessary knowledge to hold management fully accountable for the conduct of cooperative business. Costs often tend to exceed those of private trade, particularly when cooperatives become saddled with a large bureaucracy and high overhead costs. Moreover, as the experience of many less developed countries has shown, private trade often develops qualities of enterprise and management which are essential to industrial development and of which Africa is still critically short.\textsuperscript{10}

\textsuperscript{10} Though it is not the purpose of this study to evaluate the role of the private trader in agricultural development, those formulating policy with reference to cooperative and state marketing organizations should be aware of the impact of such organizations on private trade and the acquisition of business skills among the local population.
Cooperatives and politics

Another danger arises from the continued identification of cooperatives with political parties and the possible subordination of their economic to their political role. In some countries the formation of cooperatives was part of the general movement of emancipation from colonial domination and therefore inevitably had some degree of political inspiration. This was true, for example, of the Victoria Federation in Tanzania and of the cooperatives started in the Bugisu District of Uganda. Experience shows that cooperatives can also easily become a base from which politicians operate. Cooperatives that become an instrumentality or an extension of a political party rest on potentially unstable foundations and run the risk of forfeiting their members’ support by becoming involved in political strife. When the political party is also the ruling party, there is a danger that cooperatives will become virtually an agency through which the government implements its policies and directives without ever consulting the wishes of the members. This in turn may aggravate the tendency of many farmers to regard the cooperative not as their own organization but as simply another “external” agency which seeks to control and even exploit them.

Training and supervision

It is seldom easy to promote among the members of a cooperative an intelligent and enlightened interest in the management of its affairs, or an adequate understanding of the principles of cooperation. Elected members of cooperative committees often fail to realize the need for trained and well-paid staff. They may use their position for personal gain. Peculation and abuse of trust by staff members are not infrequent. The very fact that cooperatives often have a monopoly of marketing and processing tends to free them from pressure to become efficient. The quality of produce marketed (and hence income) occasionally suffers because society committee members and staffs are reluctant to risk unpopularity by vigorous insistence on proper standards.

Training is of paramount importance to cooperative development; it is required at all levels, in various subjects, and in varying degrees of depth. Training must not be confined to the paid staff of cooperatives, but extended to the committees which are periodically elected by the membership of the cooperative. Training of committee members has generally been neglected, in spite of the fact that a lack of understanding of cooperative principles and problems by such committees is one of the most important causes of cooperative shortcomings. Concentration on staff training alone tends to increase
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the educational gulf between the committee and top staff, creating
distrust on the part of the committee and often contempt on the part
of the staff. Staff training is needed in a variety of subjects including
technical problems relating to the particular crops or products which
the cooperative is handling, elementary bookkeeping, more sophisti-
cated accounting, and credit administration. Courses in particular
crops may be available at farmers’ training institutions, as they are
in Kenya, but there are seldom adequate facilities for training in
other subjects.

We have already indicated that the agricultural extension service
should have some responsibility for stimulating cooperative action
related to agricultural development and for advising cooperatives
on their substantive operations. A special government department
is usually responsible for ensuring that cooperatives are organized
and administered in accordance with the law and that their financial
management conforms to certain standards. To what extent it should
advise rather than intervene and control is always a difficult issue.
In 1962, for example, the Government of Tanzania took action
against certain abuses in cooperative management by prohibiting
the payment of honoraria to members of cooperative committees at
the federation and union level and requiring government approval
for the hiring and dismissing of certain types of cooperative person-
nel. Such controls may be necessary as a transitional measure to pro-
tect cooperatives against mismanagement, but it is obviously inimical
to establish cooperative principles for a government to exercise
permanently powers of this type. The major purpose of government
supervision is to ensure that members get the benefit of an objective
analysis of the finances of their cooperative on the basis of which the
members may judge the management. This can be achieved only by
periodic inspection and auditing of accounts. Unfortunately the
staffs of government departments are not always capable of carry-
ing out their functions of advice and control.

This exposition of the pitfalls and the shortcomings of cooperatives
and of the problems involved in the training of their personnel and
the supervision of their operations should not be considered a dis-
paragement of their accomplishments in the past or of their poten-
tialities for the future. The chances that they will play a constructive
role in agricultural development will be greatly enhanced, however,
if there is a realistic grasp of their limitations and a continuous effort
to keep them responsive to the needs of the farmers whose organiza-
tions they are supposed to be.
CHAPTER TEN

THE SUMMATION

Past progress and its limitations

Agricultural progress in tropical Africa has been impressive in some respects, but uneven and limited in others. In the adoption and rapid growth in output of many new crops the record over the past four decades has been notable. Tree crops have witnessed a particularly remarkable development. African farmers have for the most part readily taken up the production of coffee—both robusta and arabica—cocoa and, more recently, tea. The cultivation of annual crops for the market has progressed less rapidly, although there has been here and there a substantial growth in the production of such crops as cotton and groundnuts. The production of food, except that grown specifically for the market, has remained largely untouched, with farm families satisfying nearly everywhere their own basic requirements and using time-honored and simple techniques. Little change, too, has taken place in animal husbandry, since in general breeds have not been significantly improved and natural grazing land and stubble are still the only means of feeding livestock. Except for the use of draft animals in some areas, there has been little integration of animal and crop husbandry. For those who combine livestock keeping with the cultivation of crops, livestock are usually not a source of regular income but rather a means of meeting social obligations and of saving for emergencies and special needs. Only in a few limited areas such as the temperate highlands of Kenya have Africans enclosed pastures and adopted a rather sophisticated type of dairy farming with productive exotic cattle, following in this respect the European farmers settled in their midst.

The areas that have made the greatest progress in commercial agriculture have been the warm, moist forest zones of West Africa and the Congo basin, and the higher, temperate and well-watered regions of East Africa. In the first it has proved possible to grow, in partially cleared forest, profitable tree crops with relatively little effort and without necessarily sacrificing the cultivation of sub-
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sistence crops. In the second, conditions have been favorable to the adoption of a wide range of temperate zone crops as well as arabica coffee, tea and exotic types of cattle. Within this area the African farmers in Kenya have made the most progress, benefiting from the example of the European farmers who pioneered the development of commercial farming in that country, the incentives and opportunities provided by enclosure, registration and consolidation of land, as well as various forms of government assistance particularly in extension services and marketing. On the other hand, the drier, savannah-type areas in all parts of tropical Africa have experienced the least development. Here the seasonal and erratic nature of the rainfall and the poverty of the soil have frequently combined to make agriculture rather hazardous and to render difficult the reconciliation of subsistence food production with the adoption of cash crops. In some parts, however, development has been possible owing to better soils, the adoption of animal traction, more convenient access to markets and, more rarely, as in the Gezira, to the provision of irrigation.

It is noteworthy that the many large schemes launched by governments have not in the aggregate made a very significant contribution to development. These schemes have ranged from settlement projects, with or without irrigation, to large-scale state or quasi-cooperative farming and have usually entailed heavy investment and management costs. Many have proved failures, and others, with relatively few exceptions, have enjoyed but limited success. By and large it has been the individual farmers working within a gradually changing traditional environment who have accounted for most of whatever progress has been achieved. Yet their response to innovation has often been very limited. While they have adopted many new crops, their methods of cultivating these crops have frequently failed to conform to the recommendations urged upon them by professional agriculturists. To intensive cultivation they have often preferred extensive methods of raising production. In most cases they have ignored the counsel of timely planting and weeding or of the use of manure and fertilizer to raise their yields. Efforts to make them aware of the dangers of soil erosion or of uncontrolled grazing have for the most part proved ineffective.

We do not propose to give here a complete résumé of all the factors that have been responsible for inadequate or lack of response to development efforts in many cases. We shall only highlight a few of them.
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Limitations in approach

The frustration and waste of many of the government efforts to develop agriculture have been due to a failure to appraise correctly in advance what responses particular projects or measures are likely to elicit. To correct this is a major challenge both to the African governments themselves and to those governments and international institutions seeking to assist them in the task of agricultural development. We have repeatedly stressed that these responses can be assessed only in the light of all the interrelated factors—ecological, social and economic—that are likely to influence them. Successful development of agriculture often requires an intimate understanding of the society within which it is to take place—of its system of values and of its customary constraints. It has not been enough to know the technical methods by which yields of crops or livestock could be raised; it has been necessary to understand what incentives the farmer needs to change, what practical difficulties he encounters in introducing change, what his traditional pattern of land use is and how this pattern or system can be upset by thoughtless innovation. We have emphasized the many subjects that may be relevant to the adoption of change—the kinship and political organization of the society, land tenure and inheritance, the division of responsibility between men and women, demographic pressures and labor migration, income and expenditure patterns among farmers; and we have underlined the importance of keeping in mind that these conditioning factors are themselves changing under the impact of outside influences.

The professional agriculturist concerned with development has frequently appreciated the importance of understanding the whole setting, but he has often not had the time, the inclination and the training to evaluate all the facets of development. He must be able to invoke the help of others such as economists and social anthropologists in devising proper approaches to the human factor in agriculture, especially in cases where development has proved difficult or intractable. It cannot be assumed that African political leaders and civil servants who have replaced Europeans are automatically capable of understanding all the broad implications of development and devising the best ways of bringing about innovation in indigenous societies. The type of orientation and education which they have had hardly enables them to understand all the problems of their own environment; and within each country there are usually a number of societies at various stages of development, with different organizational structures, different customs and different degrees of exposure to external influences.
Outside experts who are sent from time to time for brief periods to appraise or advise on particular schemes or programs for agricultural development may well experience considerable difficulty in carrying out their task unless they are enabled to acquire an appreciation of the broader setting and particularly the socio-economic factors conditioning development. Non-African governments and international institutions engaged in financial and technical assistance programs should seek as far as possible to build up a staff which will become progressively more experienced and knowledgeable about the broader setting of agricultural development in tropical Africa. Such a staff should be able to appreciate more accurately the nontechnical factors that play such an important role in determining the success or failure of particular approaches to development.

_Inadequate appreciation of incentives_

Development measures in the past have often failed because incentives have been inadequate from the standpoint of the farmer. The profitability of proposed innovations, particularly in terms of alternative uses of the farmers' labor and land, has often been uncertain or insufficient. Farm economics has been generally neglected until very recent times. There has been a tendency to underestimate the incentive African farmers require to adopt change. In large part this is because many put a rather high value on their labor. They are not necessarily interested in maximizing their income if this interferes in their view with the social and leisure activities to which they attach importance. There is still a large gulf between the aspirations of African leaders and those of much of the rural population. Although income expectations may be rising, many Africans still tend at a particular point in time to have a target income concept from which only substantial inducements may cause them to depart. Given their disposition or capacity to put in a certain amount of labor, African farmers have often found that extensive methods of cultivation gave them a better return than the more intensive type of production they have been urged to adopt. Measures to raise yields per unit of area nearly always involve more labor; and in general farmers have been inclined to accept only those which are not very laborious. Frequently even modest increases in income are used to hire labor when the family's own labor resources are still not fully utilized. The amount of incentive required is likely to be in proportion to the degree of change in established methods, habits and modes of living that are involved. Substantial incentives are usually required to attract people to new settlement schemes which entail
more discipline in carrying out farming operations, conformity with new patterns of farming and a rupture of existing social ties.

In some respects, therefore, the success of agricultural development depends and will continue to depend on the priority the African gives to more production. With a change in attitudes and values, greater output can often be obtained through harder and better-directed work. However, it should be recognized that there are important seasonal labor bottlenecks in African agriculture which cannot simply be overcome by a readiness to do more work. In fact, Africans often work very hard at seasonal labor peaks though men may in many cases lag behind women in the effort they make at such times.

Insufficient attention to manpower and equipment

Indeed, efforts to introduce new crops or specific improvements in crop and animal husbandry have often met with a disappointing response because their implications for the use of farm labor have been given little or no consideration by their protagonists. We have stressed in this connection the importance of identifying the labor bottlenecks in each case. In recent years farm labor studies have been initiated, but far more investigations are necessary to determine for each area what male and female farm labor is available and to what extent and for what tasks total farm labor resources are being used at various times of the year for both agricultural and nonagricultural tasks. The labor implications of possible new and more productive farm practices and systems need also to be worked out, so that their practicability in relation to existing labor use patterns can be tested and the possibilities of alternative allocations of available labor can be fully examined. Outside technical assistance for this type of work could be very helpful in promoting a more effective approach to development.

The existence of actual or potential labor bottlenecks emphasizes the importance of a proper assessment of the means available to cope with them. Such labor studies as have been made demonstrate that there are wide differences in the degree of efficiency with which farmers use available labor. More efficient labor use is thus one of the means of overcoming the bottleneck; and it is accordingly important to determine to what extent more efficient methods of using labor can be propagated by an extension service. The actual and prospective access to outside labor must also be carefully assessed; and in this connection we have noted how significant a contribution the availability of large numbers of migrant laborers has made to the success of the Gezira scheme and to the expansion
of tree crops in West Africa. But probably most important is the role which implements and machinery can play in eliminating bottleneck operations and improving the timeliness and quality of certain farming operations. African agriculture is still largely unequipped or ill-equipped. What kinds of implements and equipment and what types of draft power can best be used under various conditions has never really received adequate attention. In Chapter VI we have discussed the complex of factors involved in the appropriate choice of equipment and emphasized that the use of animal-drawn and tractor-drawn implements in many cases involves a rather fundamental transformation of agriculture, including the adoption of new methods for maintaining soil fertility and for regrouping land. Experience shows that both animal-drawn and tractor-powered equipment have their limitations, but that ill-considered and excessively ambitious ventures into mechanization have been and continue to be a great cause of waste. Unfortunately the results of past experience have often been inadequately recorded and analyzed, so that the same mistakes tend to be repeated. There is an urgent need to push development work on equipment and to experiment on a pilot scale with different types of equipment and draft power. We have stressed the importance of vesting in an appropriate international institution responsibility for encouraging and coordinating such work and, above all, for recording and analyzing the results achieved so that countries may profit more fully from each other’s experience.

Poor timing of government action

Poor timing of government-initiated development measures and projects has been an important cause of failure. Government intervention has often taken the form of efforts to help farmers adjust to changing circumstances; but the need for such adjustments has not always been appreciated in the same way and at the same time by both parties. Resettlement schemes have at times proved premature. In many cases governments have launched programs to raise yields on the implicit or explicit premise that there was an increasing population pressure on land and accordingly a need to maximize returns to land at a time when the farmers were obviously still concerned only with returns to their labor. Though African populations have shown a certain capacity to adjust spontaneously to changing conditions as they perceive them, the fact of the matter is that today they are not adjusting satisfactorily to the slow but steady deterioration of their natural environment. In the face of gradually increasing population pressure and rising standard of living expectations, timely government action is absolutely essential.

If the timing of development measures is to be improved, a number
of steps must be taken. For one thing, there must be a greater appreciation of differences in circumstances. Uniform solutions and approaches are inappropriate even in the same geographic area when there are critical variations, particularly in the degree of the pressure of population and livestock on the land. Development plans must be tailored to the specific problems found in specific areas. This is essential if farmers are to appreciate the relevance of proposed measures to their particular needs. However, this kind of planning can only be done in many cases if much more information is developed on such subjects as the capability, availability and distribution of land in relation to population and stock, on land tenure and on current land use in relation to possible alternatives. In gathering these data it is especially important to appreciate the rate at which the critical factors are changing so that emerging problems can be detected.

Secondly, proper timing can be achieved only if people are made to understand their problems and the types of measures which they must accept for a proper solution. In the long run education can, of course, play an important role in broadening farmers’ horizons and their capacity to understand the need for change. In the shorter run the principal reliance will have to be on African political leaders at both the national and local level. It is their responsibility not simply to stress the urgency of development, but to appreciate that progress cannot be dictated, that it requires the underpinning of careful research and investigations and that it often involves far-reaching changes in customs, practices and values which are likely to be accepted only with their active support.

Deficiencies in extension and research

This necessary task of educating the farmer, of broadening his horizons and sharpening his awareness of the problems, has in the past often been seriously prejudiced by the way in which governments have approached it. The early reliance on compulsion and direction to effect changes was presumably based largely on the assumption that farmers would eventually perceive the merits of such changes as the result of practical experience. Too often, however, it has turned farmers against innovation and saddled the government agricultural field service with a legacy from which it is still suffering in some countries. It has now generally given way to undoubtedly time-consuming but potentially more effective methods of persuasion through extension services and training facilities. Some new and promising approaches to extension and training have been developed.
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In general, however, there is still too much of a tendency to consider extension work exclusively as a task of telling the farmer what he should do. Before the farmer can be taught, there must often be a better understanding of the rationale of existing farming methods and of the problems the farmers perceive in adopting proposed recommendations for improvements. These problems may relate to doubts about the profitability of proposed innovations or about their practicability in the light of the availability of labor, credit, essential supplies and equipment, etc. Whatever they are, they must be taken into account in devising an extension program with a substantive content that will appeal to the farmer.

Here again good local political leadership is often needed to reinforce the extension service in helping farmers to realize the nature of their short- and longer-run problems and the relationship between the problems of individual farmers and those of the community as a whole. The measures which will be necessary to meet these problems, including perhaps some degree of compulsion, will then be better understood and cooperation may be more readily forthcoming.

We have seen, however, that in a number of areas efforts to improve farming have failed simply because the agricultural extension service really has not had a program of such substantive content. In part this has been due to shortcomings in research, the consequences of which have been aggravated by the failure to pool and utilize effectively the research that has been carried on in many places with similar problems and conditions.

The research stations of tropical Africa have undoubtedly done much useful work, particularly in devising improved varieties of commercial crops and techniques for raising their yields. However, many of them have given insufficient attention to the economics of innovations in farming or to the farm management problems that arise and must be resolved to make such innovations feasible under the conditions under which farming actually takes place. The gap between research stations and farmers has often been excessive because there has not been enough applied research and testing of research solutions through pilot extension schemes. In the past a considerable increase in African farm production has been obtained by concentrating on the introduction and improvement of particular crops. However, this type of piece-meal innovation has also had its limitations. Sometimes it has upset the equilibrium of the old farming system without replacing it with a new and balanced system. Thus more attention needs to be given to the development and testing of new farming systems including rotations which would give appropriate place to both subsistence and cash crops and would
ensure maintenance of adequate soil fertility. In this connection there has been too little effort to anticipate and devise methods for dealing with the whole complex of problems emerging from the constantly changing relationships between man and his natural environment. Finally, we have noted that research is still trying to find answers to quite a few specific technical problems including some troublesome issues relating to soil fertility, the development of green manuring and fodder crops suitable to various conditions, etc. Thus it can by no means be taken for granted that there is invariably a large reservoir of research findings which can be readily applied as soon as effective extension and other supporting services are organized.

**The future approach to development and external assistance**

*Identification of bottlenecks*

Throughout this report we have repeatedly stressed the large number and variety of factors that may be relevant to agricultural development and the interlocking nature of many of the measures required. However, we do not want the inference to be drawn that we are recommending the general need for large "package programs" containing something of everything and likely in the last analysis to be difficult, if not impossible, to administer. We do believe that a comprehensive and sweeping investigation is often required to determine the factors critically limiting development; but a careful reading of the case studies in Volume II suggests that, in the light of past experience, the number of factors that limit development to a significant extent (or, conversely, make important contributions to development) are often rather few in number. It is, however, very important to identify them if bottlenecks to the expansion of production are to be broken. Institutions and governments anxious to assist African countries in the task of agricultural development often find that there are but few schemes or proposals that are likely to lead directly to concrete, defined increases in output. This appears to be partly due to the fact that African farmers have already largely utilized those opportunities to develop particular crops which they found to be readily available, convenient and easy to adopt and, above all, profitable. For those areas where development has slowed or where little or no development has taken place it has now become especially important to identify the factors that have prevented the emergence of additional opportunities to raise production and to determine specifically what to do about these factors. Otherwise the vicious
circle that has brought or kept development at a dead point will remain unbroken.

Any investigation of these limiting factors must focus on areas that are clearly defined in terms of ecology and human environment. Problems can be identified and specific detailed solutions worked out only in this way. The focus should be, above all, on the factors conditioning decisions at the farm level. Are there different types of farmers, each with their particular requirements and capabilities? If there has been no improvement in agriculture, has this been due to a lack of applied research, a failure to devise measures that meet the farmers' needs? Are there particular deficiencies in the knowledge of soils or rainfall that have made it difficult to adapt crops, varieties, soil fertility measures and planting dates to local conditions? If suitable and attractive ways to raise farm output seem to have been available, why have farmers failed to accept them? Are they lacking in ambition to improve their standard of life? Are there shortcomings in the staffing and approaches of the extension service? Is it known whether farmers have the practical means to take advantage of opportunities to raise their output? Are changes in land tenure necessary? Are the required supplies, tools and equipment, draft power, etc., available, and is the necessary credit available to finance them? Once these and other critical questions involved in a detailed diagnosis are answered, it should be possible to determine the specific measures that should constitute a program to overcome the indicated bottlenecks.

Area and national planning

Any national plan will be lacking in realism unless it incorporates a wide variety of detailed measures designed to meet a correspondingly wide variety of conditions. In the past, national programming has been far too general and too unrelated to the problems of particular areas. Even where national targets or objectives have been drawn after taking into account the requirements of these areas, the ways and means of obtaining the decisions at the farm level which are needed to achieve these objectives are seldom spelled out in sufficient detail.

This does not mean, of course, that a national program for agricultural development should simply be a collection of plans for areas each of which is characterized by certain ecological and human environmental conditions. National planning is necessary to determine how and to what extent the comparative poverty in natural resources and income opportunities of one area can be relieved by giving its population access to the more plentiful resources of an-
other area. In this connection, African political leaders face a tremendous challenge to break down tribal barriers which in many countries perpetuate great inequalities in the distribution of land and income and prevent efficient utilization of the available resource potential. It would be idle to believe that these obstacles to the development of a truly national economy will disappear very quickly. When, therefore, national planning tackles the task of bringing the development claims of various areas within the financial and other limitations governing the whole development effort, it must recognize that the problems of the various peoples inhabiting the country must be largely resolved within the confines of their own regions. While too much effort can easily be lavished on an area of very low development potential, it would be equally unwise to insist on concentrating solely on regions of the highest potential in the interest of maximizing output in national terms. The claims of areas that are less well endowed but that nonetheless have a considerable population cannot simply be ignored when there are already considerable disparities in development which have given rise to social and political tension within the country. Past experience has undoubtedly shown that the problems of these less favored areas are much more difficult to resolve, but this is in part because not enough is known about their problems and not enough research has been undertaken to find ways of easing them.

Once detailed plans for development have been adopted, the coordination of government agencies at all levels—farm, local, regional and national—is absolutely essential to their implementation. Because of the many factors impinging on agriculture and rural development, many agencies are necessarily concerned. Procedures and policies governing taxation and prices, marketing, financing, education and training, land tenure, etc., must all be geared to the achievement of the goals that have been set.

Some implications for foreign aid

The analysis of past deficiencies and the suggestions regarding a new approach that we have made above have a number of implications for non-African governments and international institutions that wish to assist African countries in developing agriculture.

First, they should be willing to provide financial and technical help to carry out the necessary diagnostic work that is so often the first requisite of a more effectively focused agricultural program. They might undertake complete responsibility for such investigations, or finance those carried out under contract by qualified organizations; or they might simply agree to supply some of the per-
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sonnel or to help in working out the methods and objectives of the investigation. Ultimately, of course, the African countries should be enabled to acquire sufficient staff of their own to do this work as well as the periodic evaluations of continuing programs that will be needed.

Secondly, governments and institutions providing assistance should make every effort to agree among themselves on the diagnosis and the appropriate remedies. There is always a danger that assistance from many sources will be inspired by quite divergent ideas about the nature of the problems and their solution. An agreed diagnosis is the first step toward a proper concert of measures of assistance. It is important not only that there be agreement on the proportionate emphasis to be given to research, education and training, credit, cooperatives, etc., but that the same orientation should be given to the approach to all these subjects. It is useless for one institution or government to support research stations focusing on problems which another that is helping to staff and reorganize an extension service does not recognize to be the ones that are critically relevant to the farmers’ needs. When cooperatives and an extension service are both to promote certain agricultural objectives, the training of the staffs serving both should be given the same orientation even though the training institutions themselves are getting assistance from several different sources. However, we would not want to discourage a certain amount of experimentation with different types of approach in view of inevitable uncertainties regarding the response that may be forthcoming; and we would even positively recommend outside assistance in carrying out such pilot programs. Unfortunately the past has repeatedly witnessed costly and wasteful attempts to raise production, such as a large-scale resort to mechanization, without prior testing.

Thirdly, there must be a willingness to attack the bottlenecks that a proper diagnosis has shown to stand in the way of immediate increases in production. In many cases the most urgent need may be to expand the facilities for research and for the education and training of professional and subprofessional personnel. The very fact that benefits from expenditures for these purposes do not lend themselves readily to quantitative assessment should not be regarded as an obstacle to financing. We are not suggesting, of course, that assistance should be extended without any judgment concerning the probable benefits. An exaggerated emphasis on quantifying costs and benefits may, however, lead to an excessive inclination to favor specific schemes focusing on a direct increase in production on the ground that it is easier to carry out the necessary quantitative
evaluation. In the case of research, training and extension this type of assessment is much more difficult and hazardous. This is particularly true when resources are to be pledged to agricultural research and one can determine only in the long run whether useful results will be achieved. The provision of assistance for research will have to be justified by a finding that it is necessary to break a bottleneck to the development of production possibilities, and the amount of such assistance will require some judgment of the prima facie production potential of the area on which the research will focus. Aid for extension work must be contingent, of course, on the availability of a “package of inputs” that has been tested and that the farmer is likely to find rewarding. Even so it will hardly be possible to assess accurately in advance how appealing the farmers will find the “package” and how rapidly they will respond to the methods employed in extension work. For this reason governments and institutions furnishing any form of assistance for extension and training programs will do well to insist on a periodic assessment of the results that are being achieved.

Fourthly, those providing external aid should avoid “picking the eyes” out of development. We are not suggesting, of course, that assistance should be extended without reference to marked differences in the potentialities for raising output, but rather that there should be no exclusive concentration on the things that are comparatively easy to do. In a sector such as agriculture where development is apt to be more risky and uncertain, there is an especially great temptation to become identified with only the comparatively few schemes or measures that seem most assured of success. This may enhance the reputation of the government or institution extending the assistance, but the effect on development may be negative if the bulk of the agricultural program is carried out ineffectually without any external aid or guidance. It must be recognized, of course, that limitations of qualified personnel and financial resources may dictate some concentration of effort on the part of those extending assistance, but this should not mean that particularly difficult though critical development problems will be largely or wholly neglected.

Fifthly, technical and financial assistance will often have to be extended for a variety of purposes, i.e., to tackle, in proper balance and sequence, the limiting factors revealed by the diagnosis. A number of interrelated aspects will generally merit simultaneous attention partly because none may be large enough by itself to warrant assistance, and partly because quite a few are likely to be
handled more effectively if some degree of continuing technical as well as financial help is given from abroad. There is a danger that foreign aid agencies, anxious to facilitate the commitment of substantial funds, may indirectly encourage the formulation of large investment schemes of the type which past experience has shown so often to be a failure. In essence, more program assistance must be extended, provided the program is elaborated in considerable detail and the disbursement of aid can be linked to the effective execution of the most critical parts of it.

**Finally,** a large proportion of financial aid should go to defray recurring rather than investment expenditures and without reference to whether or not the expenditures financed are incurred directly in foreign exchange. Development entails, above all, continuing outlays on staff, training and education, and on seasonal supplies of fertilizers and insecticides, and a considerable part of these are in local currency. To confine external financing largely to investment expenditures tends to put too much of a premium on large and costly schemes which have so often proved to be failures. The criterion for determining the type of expenditures to be financed should be solely their contribution to a properly integrated program for promoting development, including the conditions essential to the emergence of additional opportunities for raising production. The financing of specific investments undoubtedly has an operational advantage in that disbursement is automatically limited to the period required for their completion. However, current outlays can also be financed for limited periods as long as there is in principle a readiness to make new commitments at regular intervals. Whether current or investment expenditures are financed, it will in any event be necessary to renew commitments, since development objectives are unlikely to be achieved unless they can be prosecuted consistently over a long period.

**Conclusions on certain aspects of development**

Our examination of particular experiences with agricultural development in various parts of tropical Africa obviously does not enable us to prescribe the composition of development programs and schemes designed to meet the widely different conditions in that part of the world. The problems and situations encountered in our case studies will seldom or ever have their exact counterpart elsewhere. However, the case studies do suggest certain conclusions about the handling of aspects of development which are likely to be common to many situations. We shall attempt to sum up the
more salient of these conclusions which have been discussed in greater detail in preceding chapters.

Research and extension

Both of these should start from a sound understanding of existing farming systems and their constraints. Greater attention should be paid to the farm economics, practicability and social implications of proposed innovations. To this end agricultural economists, practical agriculturists and social anthropologists should be more intimately associated with the planning and evaluation of research work, and the research stations themselves should engage more in pilot testing of research results in the farmers' milieu. To make the best use of scarce research personnel, steps should be taken to promote more effective dissemination and use of the results of research carried on in various parts of tropical Africa. There is no point in establishing an elaborate extension service until there are profitable and feasible innovations available for propagation. The orientation and organization of extension services should be inspired by their dual role of reflecting the farmers' problems and requirements and of persuading the farmers to innovate. In most cases the extension service will be more successful in identifying itself with farmers and responding to their needs if it is organized as a separate service. The same objective is likely to be advanced if effective steps are taken to associate with the extension service practicing farmers who are representative of their local community and can be expected to have some influence with their fellow farmers in their part-time extension work. The methods and approaches of extension must be largely tailored to the organization, structure and degree of evolution of each society. The extension service must be enabled to facilitate access to the supplies and equipment farmers need, at least until cooperatives or private trade can fully assume this responsibility. While the extension service should not be diverted from its primary task of stimulating agricultural production, it should alert other government services to the need for action in other fields such as water supply, public health and other local improvements which in some cases may provide a significant stimulus to output and help to create a greater receptivity to other innovations. One of the most important requirements of extension is the periodic evaluation of its work. Such evaluation can provide invaluable guidance in determining what types of farmers are most receptive to change and in altering and reorienting the content and methods of the extension program for the purpose of coping more effectively with the obstacles to innovation that have been revealed.
Training and education

These must be considered in relation to farmers and the personnel who deal with them. Farmers have generally shown a positive response to education, including both formal and informal learning experiences. Formal education does not necessarily alienate people from agriculture as long as there are profitable opportunities for commercial agriculture; and the very fact that educated Africans usually retain a close link to the land often causes them to give at least some part of their time to farming and makes them, in such cases, more inclined to innovate. Experience in Kenya and some other countries has demonstrated that, once some initial receptivity to change has been created, it is very useful to complement field extension work with facilities for giving farmers short courses which will give them concentrated practical training in particular subjects. The response to this type of training in Kenya has been very good, although there is still need for improvements in the curriculum, methods of instruction and coordination with field extension. The training or education of the subprofessional and professional staff dealing with farmers and farm problems has been handicapped at times by lack of facilities, but more often by deficiencies in curriculum, teaching materials and teachers. Usually there must be much greater concern with the relationship between what is taught and what is practiced and with the practical ways and means of bringing these two into greater harmony. For this reason we would again stress the importance of systematically collecting all the relevant information on farming patterns and ecological and social conditions for the various parts of each country with which agricultural personnel are likely to be concerned. The various factors that are likely to affect farm-level decisions should be given far more attention. The curriculum of these institutions, as well as of farmers’ training centers, should also generally give more emphasis, albeit at different levels of sophistication, to such subjects as the proper use and maintenance of tools and equipment, farm economics and farm management and principles of marketing and price determination.

Land tenure

Government intervention in land tenure which is so basic to Africans’ sense of security is always a delicate matter requiring careful timing. Where opportunities for profitable farming have developed, there has often been a general, spontaneous evolution toward unqualified individual rights to land. As Kenya’s experience indicates, intervention to terminate land litigation, to bring about enclosure and consolidation, and finally, to register land may provide
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a strong incentive to development under certain circumstances. Such intervention is likely to be successful only when

1. land is becoming scarce and the by-products of this growing scarcity—litigation, fragmentation through subdivision by inheritance, and increasing objections to communal grazing—tend to frustrate development,

2. profitable opportunities for the development of land exist,

3. farmers have a genuine desire to develop,

4. widespread popular support for this type of land tenure reform can be enlisted,

5. farmers are given opportunities to participate very actively in carrying out the changes in land tenure, and

6. the government is able to provide them with prompt and adequate assistance in developing their land upon the completion of the land reform.

As yet there are not many parts of tropical Africa where all these conditions can be fulfilled, but when the first two conditions are present, the others can be met through effective government leadership and action. On the whole, however, there may be more widespread need for other and somewhat more flexible methods of regrouping land or of altering the customary allocation of land. We have called attention to the potentialities of some of these in facilitating the more efficient use of equipment and extension personnel, in introducing more systematic crop rotations and in fostering group solidarity and cooperation in carrying out certain agricultural improvements. Their success is also contingent on wholehearted and voluntary participation of the farmers.

Credit

A surprising amount of development has taken place with little or no credit, particularly where it has been possible to devote land and labor to market crops without affecting production for subsistence. In many areas Africans have shown a considerable capacity for savings. This illustrates the need for using credit as a means to supplement and not to replace farmers' own efforts and savings. Credit is usually most effectively administered by special, autonomous government institutions, with the extension service discharging the essential functions of assessing the farmer's capability of using credit effectively and ensuring that it is actually employed for the purposes specified. While commercial banks can play a useful role in financing well-established cooperatives and some of the larger
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individual farmers, they are not, under the conditions now prevailing in most of tropical Africa, very suitable instrumentalities for the extension of agricultural credit to the great bulk of African farmers even in those very limited areas where mortgages can be taken as a security. Credit should never be made too easy and should be confined to outlays which are well beyond the capacity of the farmer to defray out of current income. It is important, however, that it be extended not only for the purchase of supplies and equipment from the nonfarm sector, but also for the transfer, among farmers, of productive assets like land and draft animals when such transfer will ensure more efficient use of these assets. The repayment of credit has been an acute problem in many areas and has often been aggravated not so much by the misuse of credit as by the failure to insist from the very beginning on strict observance of the obligation to repay. Cooperatives should be geared into the extension and collection of credit as soon as possible in order to give farmers a greater sense of collective responsibility for effective credit administration and to utilize the opportunities of recovering loans through deductions from the proceeds of crops marketed by cooperatives.

Marketing

While we have not examined the operations of marketing organizations in any detail, we have noted that they have encouraged a widespread and dangerous notion that prices can be arbitrarily fixed at any level. In the early stage of development, judicious measures to support or stabilize prices may play a useful role in encouraging production for, and reliance on, the market. However, the role of fluctuating prices in stimulating change has on the whole been underestimated; rising prices have often encouraged innovation, and declining prices increase pressures for more efficient production. Market limitations are undoubtedly handicapping the development of African agriculture. While one should not discount the possibility of increasing the African share of the world market in view of the low opportunity costs of production of African farmers, more emphasis will need to be put in the future on the development of African markets. Cultivation of the growing urban market in Africa will in turn necessitate more attention to efficient production of foodstuffs and to their processing and marketing in a form that will make them as convenient to transport and consume as many of the foreign staples now imported. At the same time, however, specialization of production and exchange among farmers themselves need to be encouraged if a broader market is to be developed and
productivity increased. We are not proposing that this be done in areas which still have had rather limited contact with the market and where remoteness and high costs of transport will put a continued premium on farm self-sufficiency. In the more developed and accessible areas, however, farmers should be gradually weaned from the practice of continuing to produce virtually all the food they need irrespective of more profitable alternative uses of their land. We have suggested various measures to this end: exploration of the possibilities of a "division of labor" among ecological areas and even among different types of farmers within the same ecological area; the creation of a greater awareness among farmers of the opportunity costs of subsistence crops; efforts to reduce women's interest in farm self-sufficiency by ensuring them a greater share of cash income; improvements in communications; and the reorientation of certain official marketing policies and practices.

Cooperatives

Much effort has been devoted to the organization of cooperatives in the past, and today African leaders and governments are even more determined to give them an increasingly important and expanding role. Some cooperatives, notably in East Africa, have impressive accomplishments to their credit, particularly considering the limitations in education and training which have handicapped them. The functions and organization of cooperatives must obviously be determined in large part by local requirements and the level of education and sophistication. Even in societies where there is little or no education, small, and often informal, cooperative groups working under the guidance of an extension service can be used as a means of giving their members mutual support in innovation, in trying new methods of cropping, in testing and even owning in common new equipment and, occasionally, in providing collective guarantees for borrowing. The more usual functions of cooperatives are the collection, grading, storing and simple processing of agricultural products and the supplying of requisites of production. Such functions obviously require an educated staff and some degree of sophistication and experience on the part of management committees. Full responsibility for credit administration poses even more stringent requirements. It is hardly surprising that cooperatives have shown many shortcomings in efficiency and in the proper administration of their funds. Their monopolistic character has often deprived cooperatives of the requisite spur to efficiency. Experience shows that cooperatives must be constantly on their guard against
being used as political instrumentalities and against becoming involved in a rapid expansion of their functions and bureaucratic organization that overtaxes management capacities and alienates them from their members. Like an extension service, a cooperative is truly effective only if its members identify themselves with it and consider it their organization.

The personnel bottleneck

One of the most important bottlenecks is the shortage of qualified personnel. It is obvious that this must be a governing consideration in what can be undertaken in each country. The number and quality of African personnel are likely to increase only slowly, since even special efforts to recruit, train and educate them will not fully counter the comparative attractiveness of the numerous other opportunities still open to educated Africans. While this does not detract from the need to improve the conditions of service and to strengthen and reorient the training of Africans, it should be recognized that considerable foreign personnel will be needed for some time. Unfortunately the process of Africanization has brought about serious losses of expatriate personnel. Undoubtedly some of these expatriate officers were not very effective, owing to limitations in their approach, particularly to the human agent of production; but many did acquire invaluable experience. Of the latter some have found employment with national and international agencies which enable them to contribute in a continuing or sporadic fashion to the development of African agriculture, but the services of many others have been or are being lost. We believe that it will be useful for some international agency to undertake a survey to identify those who by virtue of their experience and adaptability to the new conditions in Africa should be able to make a continuing contribution to African agricultural development and to explore how they might best be assured such an opportunity.

There are two types of personnel shortages: one arises from the departure of the many non-Africans previously employed as agricultural scientists, agricultural officers, veterinarians, etc.; the other

1 Some efforts have recently been made to arrest this development. In 1965, for example, the Government of the United Kingdom took steps to create and support a number of posts within the Ministry of Overseas Development, other Government ministries and universities, for people capable of filling various assignments in the less developed countries, including assignments related to agricultural development. In the same year the International Bank for Reconstruction and Development took steps to establish, at its regional office for East Africa, a small agricultural advisory service.
from the need to complement the traditional staffing with people from other disciplines, particularly economics and social anthropology, in order to broaden the approach to agricultural development along the lines that we have indicated. In the first group the most acute shortages are perhaps among agricultural scientists and veterinarians. We have emphasized particularly the danger of a critical shortage in the type of personnel that can direct and conduct research in tropical agriculture. It is likely to be a long time before sufficient Africans are available for such research, the need for which will be greater rather than less in the future; and few non-Africans are likely to be interested in research careers in tropical agriculture. In Chapter 3 we have pointed to the urgency of considering ways and means of giving non-Africans, within the framework of national and international institutions, assured opportunities of pursuing a research career in tropical agriculture.

As for the second group of personnel, it is vitally important to make available more agricultural economists and social anthropologists if, as we have recommended, much more attention is to be devoted to analyzing human reactions to change, to assist in the work of diagnosis and planning and in the periodic evaluations that are necessary. In terms of numbers, the greatest need is for agricultural economists to ensure more consideration of problems of farm economics and farm management. Economists, like agriculturists, should be given the opportunity for pursuing careers in tropical African agriculture, particularly because cumulative experience of the environment will greatly increase their usefulness. Initially it may prove more difficult to find enough social anthropologists interested in more or less permanent assignments to international or national agencies concerned with agriculture. In their case it is in any event important to identify those who have been particularly concerned with the dynamics of change and who may respond to the challenge of becoming practically involved in devising approaches to African farmers that will improve the prospects of successful development. In this way it should be possible to create a reservoir of talent from which social anthropologists can be drawn for assignments of varying duration.

The whole problem of mobilizing and utilizing the personnel resources that are needed for the development of African agriculture should be examined carefully by interested international institutions in consultation with national agencies or organizations which have made such personnel available. It is not simply a task of finding more personnel, but also of exploring the means by which such personnel
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can acquire the knowledge of local conditions, particularly those affecting farm-level decisions, which is a prerequisite to their effective work whether they are engaged in research, extension, teaching or survey and planning work. The ways of inspiring an effective team approach must also be found. The development of African agriculture is so complex that it can hardly be confined to one discipline or to a number of disciplines acting more or less independently of each other.
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