Developing Ghana's agriculture

DEVELOPING GHANA'S AGRICULTURE

by

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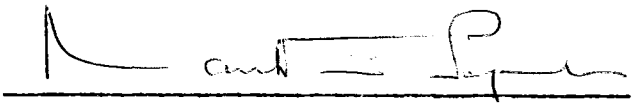
SIGNED: 

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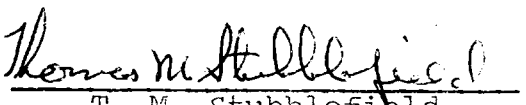

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The adage of the Akan Tribe of Ghana which literally says, "the man cutting the traverse hardly sees the contortions he leaves at his back," is so true when one ventures into a field where landmarks barely exist. The empirical studies hitherto undertaken follow the traditional fashion of tracing the trend of development of advanced or semi-advanced economies, which involve testing of economic growth models and theories, using time series or cross-sectional data. Testable models and theories for agricultural development are uncommon, perhaps, because of the variability of conditions (physical, cultural, political, institutional and organizational) within which agriculture functions and the narrow range within which techniques in agriculture are transferable.

The author makes a modest attempt, by empirical analyses, at explaining the extent and nature of weaknesses (or the agricultural output growth restraints) underlying the agricultural backwardness of an underdeveloped country that must be overcome and the strengths of the agricultural sector that must be bolstered in developing the country's agriculture. The author accepts full responsibility for any weaknesses of the approach and method applied, but owes sincere gratitude to those who by criticisms, implicit or

explicit, directed the course of the study. In this regard I am indebted to Dr. Harry W. Ayer and Dr. Lawrence E. Mack, both Assistant Professors of the Department of Agricultural Economics. I shall especially like to thank my academic adviser, Dr. Thomas M. Stubblefield, who served as the Project Director. He helped to initiate the project and offered the guidelines.

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TABLE OF CONTENTS

TABLE OF CONTENTS--Continued

TABLE OF CONTENTS--Continued

TABLE OF CONTENTS--Continued

TABLE OF CONTENTS--Continued

LIST OF TABLES

LIST OF ILLUSTRATIONS

ABSTRACT

Ghana has abundant land and labor resource base that portends a high level agricultural production. Pursuant to its agricultural development policy involving utilization of the rich agricultural resource base, the country has since its attainment of political independence in 1957 embarked upon a considerable number of development programs. The major agricultural development projects include public investments in laying down infrastructural facilities for agricultural research and education. In recent years, the country has also embarked upon development planning in the use of the abundent traditional resources and scarce, purchased agricultural production capital inputs. The common objective in carrying out these development programs has been ostensibly to achieve sustained growth (by volume) of agricultural production.

Apart from cocoa and tobacco, which are produced under organized conditions, all other agricultural production and output distribution are carried out in a maze of socioeconomic deficiencies, institutional and organizational imperfections and without motivations and incentives. These factors together constitute restraints that inhibit the agricultural output growth and thus cause stagnation of the country's agriculture

The agricultural output-growth restraints affect the output indirectly by causing mal-allocation and utilization of the abundant traditional resources of land and labor; they also affect the output by limiting deployment of the existing infrastructural facilities for agricultural research and education and supply of the purchased inputs, and hence the use of technologies in the agricultural production. Agricultural development policy of Ghana therefore must essentially consist in overcoming these output-growth restraints that are largely exogenous to the agricultural production process.

CHAPTER I

INTRODUCTION

The major characteristic of an underdeveloped economy is poverty; there is a low level of provisioning with resultant low per capita levels of living. The poverty arises from low productivity of the human agent as production resource, and from unemployment or underemployment of both human and natural resources of the economy.

There are masses of the labor force and natural resources employed at low levels of productivity, or not employed at all. The low productivities of labor and natural resources are largely due to lack of suitable equipment for the human agent to work with, and lack of technologies to aid the traditional resources in production. The unemployment or underemployment arises because capacity of the economy has never been high enough to absorb the available traditional resources. The underemployment of resources is the result of resource mal-allocation and utilization which arises from socioeconomic inefficiencies, institutional and organizational imperfections and from lack of motivations and incentives in the economy. Development of an underdeveloped economy, thus, consists in the elimination of poverty (or an abatement of a high level of poverty) by providing labor with production

equipment and technologies to raise productivities of both human and natural resources, by increasing production capacities to provide employment opportunities, and by adjusting the existing pattern of resource allocation and utilization to an uptimum level.

The Need for Agricultural Development in Ghana

Large development projects, such as manufacturing industries, including even those that provide supplies for agricultural development, and construction often generate an inordinate demand for imports of capital and technologies. Moreover, some of these schemes of investments which seem to be clearly indispensable to improvements in the long run take time to accomplish and to yield any fruit. Meanwhile, the workers engaged on these schemes have to be supplied with food and the basic needs. The development priority of the country during the past one-and-a-half decades, however, has been the eager desire for foreign capital for investment in the industrial urban sector while having the remainder of the country which holds the bulk of the population in the traditional social and economic state. This state has limited the growth even of the industrial sector because of restricted output of food and industrial raw materials and limited markets.

Agriculture has been the mainstay of Ghana's economy. The sector at the time of the country's political independence in 1957 engaged over 75 percent of the total population. It has been the dominant sector of the economy, contributing about 60-65 percent of the country's foreign exchange earnings and about 65-70 percent of the domestic capital for provision and maintenance of public service and utilities. The sector has been the principal source of food supplies to the nonfarm sectors of the economy and has the potentials for providing raw materials for the processing and manufacturing local industries, such as the vegetable and fruit processing industries and the textile and soap manufacturers.

In the light of the foregoing, transformation of the country's agriculture must be regarded as the key to accelerating its general economic development.

The Hypothesis of the Study

Like many underdeveloped countries of the world, in the 1960s Ghana resorted to economic planning as instrument of economic development. In agriculture economic planning has been used as a means of utilizing existing capacities rather than expanding them, and the many planned programs and projects within the decade have failed to come to expectations. The hypothesis of the study is that the low

level of agricultural productivity and stagnation of Ghana's agriculture are the result of the existence of socioeconomic inefficiencies, institutional and organizational imperfections, and absence of motivation and incentives in the socioeconomic matrix within which agriculture functions. These factors together constitute restraints which inhibit "sustained and unbounded growth" in agricultural output. Thus, sustained and unbounded growth in agricultural output and, hence, agricultural development, can be attained only by overcoming these retraints. The development process here consists in increasing agricultural productivity and expanding existing capacities and opportunities in agriculture.

E. O. Heady, writing on processes and priorities in agricultural development, states among other things,

> The variables (relating to the endogenous process per se of the structure and economic growth of agriculture) are rather obvious . . . What is less obvious is how to overcome the political, cultural, intellectual and similar restraints, largely exogenous to the agricultural development process which prevent 'getting on with the job' where it has great marginal urgency and productivity. The voids in agricultural development are to be overcome by explaining and diverting these outside conditions which prevent changing price relatives, supplying knowledge, capital and other resources, and by improving the tenure and other economic environment within which agriculture functions [McPherson 1968, p. 59].

The above statement brings out an important and relevant point of the hypothesis, the fact that economic planning as a tool of agricultural development, currently

receiving much attention in the development processes of underdeveloped economies of the world, is useful only inasmuch as it is applied as a means to overcome those restraints exogenous to the agricultural development process.

Background of the Study

Ghana is situated on the southern coast of the Gulf of Guinea, West Africa, and is bounded by the Atlantic Ocean on the south (see Figures 1 and 2 for a map of Africa and Ghana, respectively).

Ghana has a total area of 91,843 square miles, with an estimated population of 8.4 million in 1968. The country is divided into eight regions politically, and agriculturally into forty districts with most of the agricultural districts corresponding with the political districts. The climate is tropical, with temperatures ranging from 70-90 degrees Fahrenheit and relative humidity between 50-80 percent. The mean annual rainfall is 60-80 inches in the south and 40-50 inches in the north.

Ghana became politically independent in 1967, and a republic in 1960. The country is the world's largest producer and exporter of cocoa. Cocoa alone accounts for 60 percent of all exports. It is produced mostly by small farmers and represents the most important cash crop. Other cash crops of minor importance are tobacco, coffee, oil palm, rubber, kola nuts and shea nuts. Food crops include

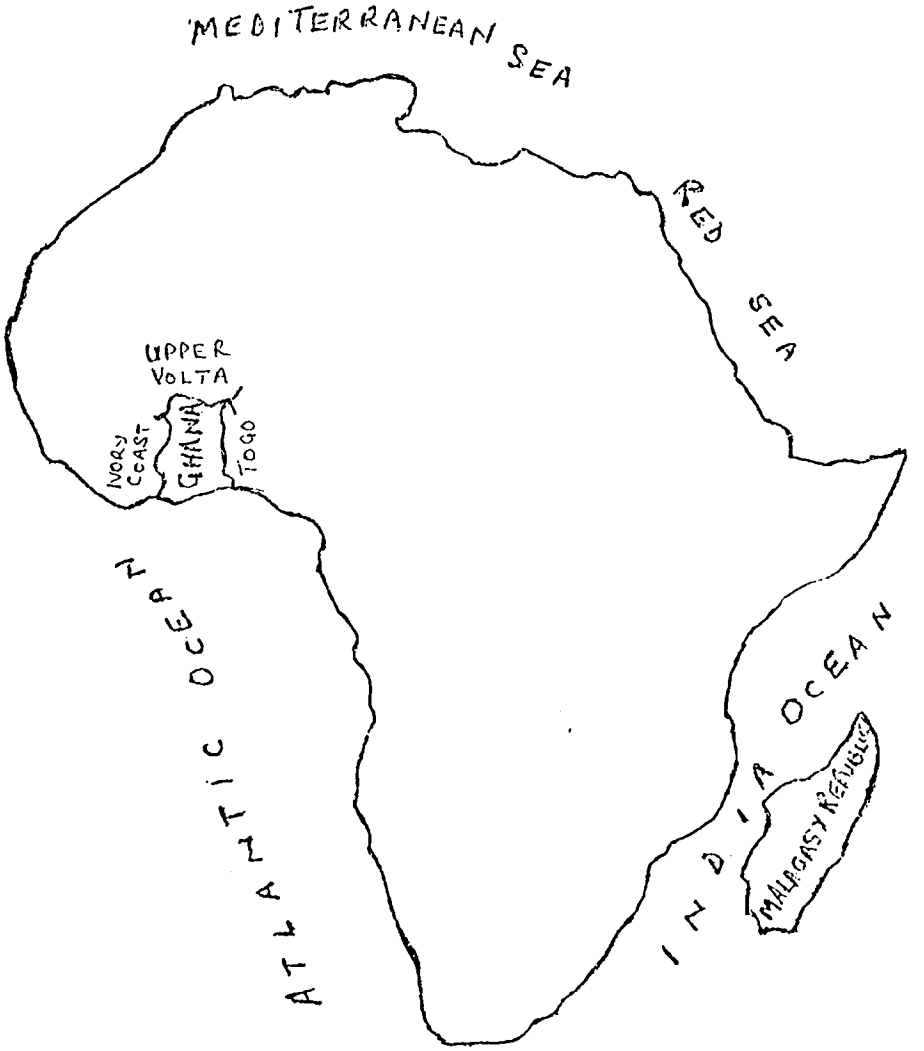

Figure 1. Map of Africa showing location of Ghana.

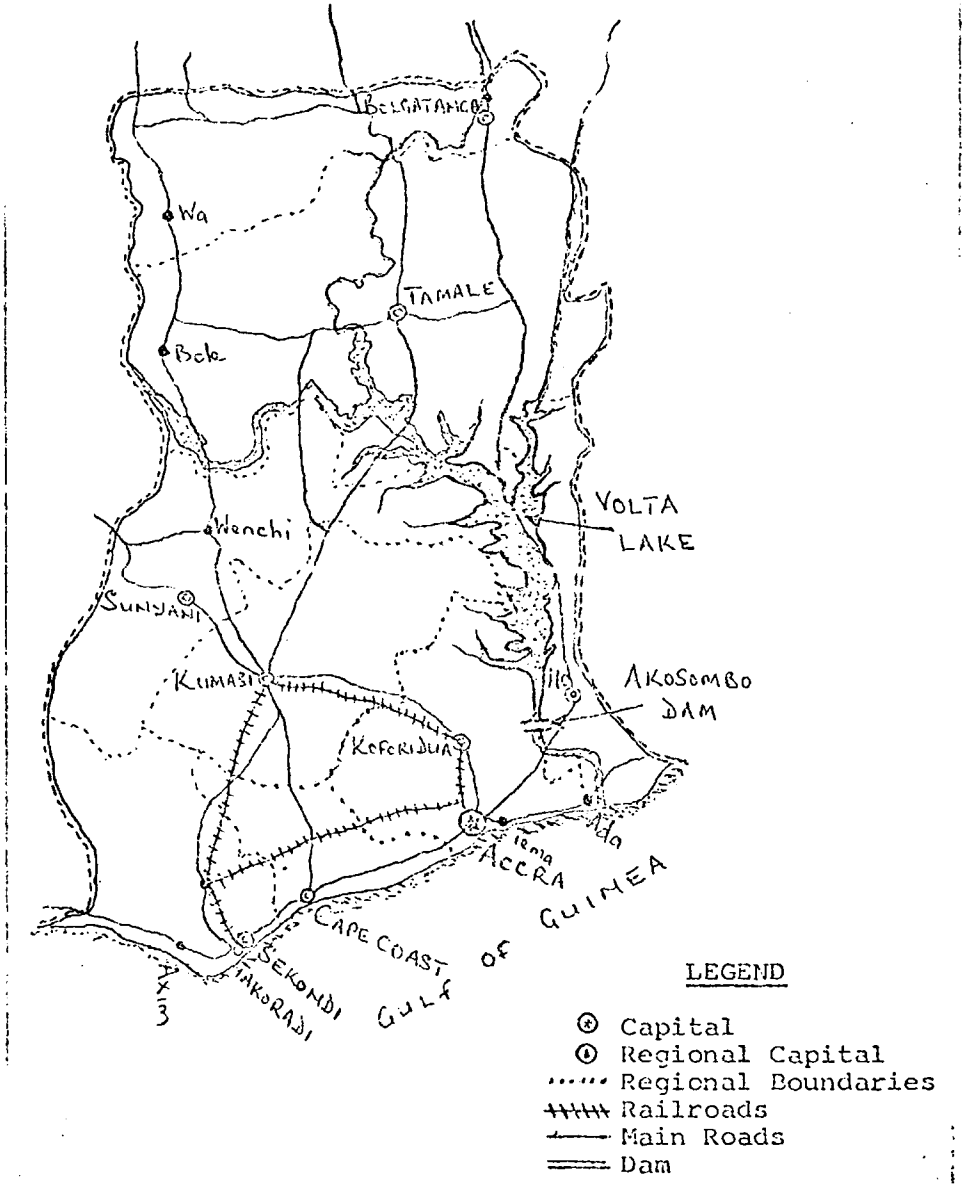

Figure 2. Map of Ghana.

corn, yams, millet, sorghum rice, cassava (manihot), bananas, plantains, tomatoes, eggplant, peppers, beans, citrus, mangoes and coconut.

A program is mounted for greatly increased sugar-cane production. Imports of agricultural products include sugar, rice and wheat flour, fats and oils, tobacco and meat products. Most of the livestock is produced in the northern part of the country (in the Tsetse-free areas). Considerable effort is being made to increase food production generally.

Ghana's exports, other than agricultural products, include timber, industrial diamonds, gold and manganese. Industrialization is expected to develop with the recent completion of the Volta River Dam which will generate about 750,000 kilowatts for industrial purposes. The dam also provides transportation and irrigation water for several thousand acres of arable land.

When Ghana attained political independence in 1957, the immediate tasks facing the country were to provide adequate nutrition for its people and to generate a national income high enough to provide more of its own resources for the maintenance and improvement of public services and utilities and also for general development of the economy.

The high rate of population growth--this was given as 2.7 percent per annum by a 1960 population census--coupled with a high income elasticity of demand for food

in the underdeveloped country meant that its agricultural production must grow at a fast rate in order to provide the high food requirements.

Since agriculture was the dominant sector of the economy, engaging about 75 percent of the total population at the time of political independence, the economic transformation process had to rely largely on agriculture for supplies of capital and manpower resources. More particularly, development of the industrial sector generated an inordinate demand for imports of machinery and equipment and initially for raw materials to feed the manufacturing industries. Agriculture was to supply, in large part, the requisite domestic and foreign capital as well as provide the industrial raw materials.

It became important, therefore, that agriculture should provide major increases in production of both exportable products and industrial raw materials. Furthermore, agricultural productivity was to increase in order to release the existing low productive labor for the nonfarm sectors of the economy without decreasing the volume of production in order to adequately meet the food, raw material, and export requirements.

Since 1957, the country has embarked on a considerable number of agricultural development programs purported

to achieve the priority objectives of [Ghana Government Development Plans 1957-70]:

1. Increasing food production to provide adequate nutrition for the growing population,

2. Increasing production of agricultural products needed as raw materials to feed local factories,

3. Generating foreign exchange potential through diversification of agricultural production,

4. Conserving foreign exchange through substitution of locally produced agricultural products for imports.

However, there has been very little progress in agricultural development between 1957 and 1970. Agricultural productivity has remained low and production has failed to withstand the pressures of demand imposed by the general economic development of the country. The country suffers from periodic food shortage with resultant inflation and high cost of living. It continues to import agricultural products, including food and industrial raw materials. Its factories using agricultural raw materials operate well below their existing capacities. The country also faces an acute problem of securing adequate foreign exchange from agricultural exports to meet its import requirements. The condition is symptomatic of an agricultural sector lagging behind the nonfarm sectors of the economy in development.

The persistent stagnation of the country's agriculture, in the face of numerous public agricultural development programs for a decade-and-a-half, signals for a stop-look-and-listen appraisal of the agricultural development process of the country. A close examination of the country's agriculture needs to be conducted and a thorough diagnosis made of the ills that plague the country's agriculture and thus inhibit the agricultural development process. The purpose of such examination is to find relevant prescriptions as control or curative measures for promoting agricultural development to guide policy makers of the country.

The Objectives of the Study

The overall objective of the study is to appraise for a recent historical period (1959-70) the responsiveness of the agricultural sector in terms of agricultural output changes, to perceived changes in agricultural resource usage under the prevailing technical, economic, and socio-political conditions. The results of the appraisal will serve as recommendations and basis for the agricultural development policy of Ghana.

Consistent with the overall objective, the major problems to resolve are:

1. To determine for the suggested period of study the changes in agricultural output which have taken place.

2. To determine the factors that are associated with the measured changes in agricultural output and their contributions and to identify those factors which have militated against increased agricultural production and productivity. The idea here is to identify the strengths and weaknesses of the agricultural sector.

3. To determine the priority measures for improving agricultural production and for increasing agricultural productivity in Ghana. The idea here is to identify and recommend the policy measures for bolstering the strengths and for minimizing or eliminating the identified weaknesses of the agricultural sector.

Method of Treatment

Step 1

The sub-objective 1, changes in agricultural output that have taken place over the period considered, will be achieved by construction of an output index. This consists in comparing the weighted series of physical agricultural output data in the specific time periods, with a weighted physical output data of a selected base year.

Step 2

The sub-objective 2 will be achieved by determining the series of physical production inputs used over the selected period and analyzing statistically the output and

input data obtained in Steps 1 and 2, using a production function. The analysis will provide the following information:

a. The responsiveness of the agricultural sector in terms of the output elasticities of the physical inputs under the prevailing technical, economic, and socio-political conditions. These output elasticities give indication of the magnitudes of the strengths and weaknesses of the agricultural sector.

b. Indication of purely economic factors, in terms of agricultural production input allocation and utilization, associated with the changes in the agricultural output.

Step 3

By further empirical analysis the noneconomic factors, in terms of "technical" conditions of the country's agriculture, representing the forces underlying the strengths and weaknesses of the agricultural sector, will be determined. By a similar procedure the forces of agricultural output restraints (institutional, organizational, cultural and political) also underlying the weaknesses of the agricultural sector will be identified.

Step 4

The strengths and weaknesses identified in Step 2 and 3 will form the basis for policy measure recommendations for bolstering the strengths and for eliminating or improving

the weaknesses of the country's agriculture--and thus achieve sub-objective 3. As far as possible, the policy recommendations will be the inferences drawn from the empirical analyses in Steps 2 and 3.

The study is based on a general survey of the existing conditions of Ghana's agriculture, identification of the factors that militate against agricultural progress of the country, and the policy measures for overcoming these militant factors.

Chapter II is given to discussion of the nature of agricultural output and the conventional input characteristics, respectively, of Ghana's agriculture. Chapter III, IV and V are discussions of the nonconventional factors; namely, technical, socioeconomic, institutional, organizational and motivational conditions, largely outside the production process, which determine the level of input utilization and the techniques of production and which affect output distribution. Chapter VI is a theoretical framework of the analysis of existing conditions of agriculture in Ghana. Chapter VII covers the testing of the hypothesis by empirical analyses of the input-output characteristics of the traditional agriculture. Chapter VIII is a set of recommendations for overcoming the factors which militate against the agricultural programs and, hence, the policy measure for developing Ghana's agriculture.

CHAPTER II

THE NATURE AND CHARACTERISTICS OF GHANA'S AGRICULTURAL OUTPUT AND CONVENTIONAL FACTORS OF PRODUCTION

The output level of agriculture of an economy in point of time is a good index of the state of agricultural development. It is a measure of the economy's ability and efficiency in transforming its resources into food and other agricultural products. A low level output, such as occurs in Ghana, is indicative of underdeveloped agriculture.

The level of output in point of time depends directly upon the quantities and quality of the conventional inputs of land, labor and capital used. Maladjustment in the quality and mal-allocation and utilization of these conventional factors of production result invariably in low level of agricultural output such as characterizes Ghana's agriculture.

This chapter is concerned with a discussion of the state of agricultural production in Ghana and the changes in the agricultural output over the period of time selected for the study. There is also a discussion of the nature of the natural endowments of agricultural resources, the organization, supplies and utilization of these traditional

resources, as well as modern production inputs and the effects thereof on the country's agricultural production.

Agricultural Production in Ghana

It is estimated that cultivated arable land and land under tree crops make up about 22 percent of the total land area of Ghana [Europa Publications, Ltd. 1971]. Cocoa is the major cash and export crop, produced on small size "peasant" farms. Other export products of minor importance are coffee, palm kernels, copra, bananas, shea nuts, and (for West African markets) kola nuts. Staple crops are plantains, cocoyams, yams, cassava and maize (corn) and millet. Some rice is grown on small size farms in the forest zone and on larger size farms in the savannah zone. All crop production is carried out at "peasantry" level.

Cattle farming in small herds is restricted to the south on the Accra Plains and to the northern savannah areas. Other livestock production is neglected and livestock imports from adjacent countries have been quite considerable. Poultry production, however, has been on the increase since the mid-1960s, the country now attaining self-sufficiency in poultry products--meat and eggs. Domestic fisheries (marine and Volta Lake) currently supply 70-80 percent of the country's total consumption of fish and fish products [Europa Publications, Ltd. 1971].

Changes in Agricultural Output

Agricultural production in Ghana over the period under study has been subject to annual fluctations in response to both economic conditions; namely, the output price fluctations, and technical conditions, such as random variation of weather and natural soil fertility and incidence of crop pests and diseases. Output of arable crops have been partly subject to the alternating annual output price fluctations and in a large measure to the random variation of the weather and natural soil fertility of the cultivated arable land (since arable farming follows a "shifting cultivation" or a land rotation system and since no fertilizers are used to replenish the soil fertility).

Output of tree crops has followed a trend similar to that of the arable crops. Annual cocoa output which averaged 240,000 tons in the 1950s rose sharply to 420,000 tons in 1960-64 and to 570,000 tons in the crop-year, 1964-65. In the next three crop-years annual output averaged 400,000 tons, but dropped to 339,000 tons in the 1968-69 crop-year. Cocoa output in the long-run has been dependent upon new planting and replanting, but in the short run it has been affected largely by weather conditions and the relationship of producer prices to farm maintenance costs which are reflected in the pests and disease control

measures taken by farmers and other farm maintenance care (such as weeding) given to the cocoa farm.

Land Resource

The Natural Endowments

Ghana has an endowment of land resources that provides high potentials for varied agricultural production. The climate is tropical and the country has potentially fertile land and varied vegetation that are suitable for growing a large variety of crops and for raising different kinds of livestock. It has a total surface area of 91,843 square miles, most of which is cultivable under tree and arable crops.

The Climate

The principal features of rainfall in Ghana are its seasonal character and its variability from year to year. Four principal types of distribution during the year may be recognized, namely [Wills 1962]:

1. A single rainy season where the monthly totals rise slowly from March, with a break in July until a maximum is reached in August or September. Monthly totals then decrease sharply. This type occurs in the extreme north.

2. A single rainy season between March and October with not much variation between the monthly totals. This type is bounded on the north by the forest types and on the south by a double maximum rainfall.

3. Two rainy seasons, with the monthly totals reaching their maximum in May, June and October. The periods, December-February, July-August are dry. This type occurs in the mid-south.

4. Two rainy seasons, the major reaching its maximum in May and June and the minor in October. There are two subdivisions of this type. In the southwest, the principal maximum (associated with the highest rainfall in the country) is particularly well marked. In the east (associated with the lowest rainfall in the country), the minor season is scarcely in evidence.

The average totals over the greater part of the country range between 40 to 70 inches per annum. The variability is least over areas of high rainfall and greatest over areas of low rainfall. The yearly totals range from 47 to 11 inches in the southeast, from 130 to 47 inches in the southwest, from 75 to 40 inches in the mid-south, and from 62 to 32 inches in the north. The average duration of rainfall is between two and three hours. Variations in intensity of rainfall are considerable and rates of eight inches per hour may be reached and even exceeded for short periods.

Except seasonal variability, rainfall is adequate for growing tree crops in the southwest and the mid-south rainfall belts, and arable crops in the northern rainfall belt. The single rainfall pattern coupled with the wide seasonal variation in the north, requires supplementary

irrigation to grow two crops in the year. Irrigation is also required in most parts of the southeast rainfall belt to make the area cultivable under arable crops.

Temperatures are high with little variation (2 to 3 degrees Fahrenheit) from year to year. For places at or near sea level, the annual mean temperature ranges between 79 and 84 degrees Fahrenheit. The annual mean maximum temperature is greatest in the extreme north (94 degrees Fahrenheit) and least on the coast (85 to 86 degrees Fahrenheit).

Relative humidities in the south are generally over 90 percent during the night and early morning, decreasing during the day to about 75 percent in the southwest and to about 65 percent in the southeast. In the north, between April or May and October, relative humidities may average 95 percent, falling to about 70 percent in the afternoons. During the remaining part of the year, average night relative humidities are below 80 percent and may fall to as low as 25 percent in the extreme north in January.

Relief

Ghana is not what is generally known as a mountainous country. The greater part of it is below 1,000 feet above sea level. No hills exceed 3,000 feet, the highest being 2,905 feet. The greatest variations in relief occur in the forest zone, rising inland from 150-250 feet near the coast

to about 1,000 feet in the northwest. This topography is to be contrasted with the gentler undulations found in the savannah areas.

Soils

The major groups of soils are the forest ochrosols, the forest oxysols, the savannah ochrosols and the tropical black earths.

The forest ochrosols are generally well drained, fertile soils occurring in the part of the forest zone receiving 35-65 inches annual rainfall. They are the most extensive and the most important soils in the forest zone, supporting tree crops, such as cocoa. The forest oxysols occur in the southwest where the annual rainfall exceeds 70 inches. The soils are more acid. The savannah ochrosols differ from the forest ochrosols mainly in that the top soil is less strongly humus-stained. These soils are heavily farmed under arable crops.

Tropical black earths [Wills 1962] are dark grey, cracking clays containing lime concretions in the lower part of the soil profile. They occur in the savannah areas of the southeast (the Accra Plains). They are not much cultivated at present. Their heavy nature, difficult moisture relationships, and the erratic nature of the rainfall have inhibited their development earlier. They require the use of heavy cultivation machinery, skilled management and

irrigation (together with drainage) and might then produce such crops as rice and sugarcane, in particular, vegetables and fodder crops. The major virtue of the soils lies in the stable, friable tilth they develop when broken up and kept well drained. They can thus, unlike the majority of soils, be continuously cropped so long as suitable fertilizers are added and precautions are taken against soil erosion.

The general nutrient characteristics of the soils of Ghana are the low level organic matter, particularly in the savannah soils; the high degree of leaching, particularly in the high rainfall areas; and the low cation exchange capacity (a measure of their ability to hold nutrients such as potassium, calcium and magnesium). The soils are most deficient in phosphorus since they contain negligible amounts of the parent material (apatite) from which it is derived. The major source of the soil phosphorus is the soil organic matter [Wills 1962].

Land Use and Organization (Land Tenure System)

This section deals solely with rural land tenure (i.e., land for agricultural purposes only) and, therefore, omits reference to towns scheduled under the Towns Ordinance or the municipalities to which applies the Municipal Councils Ordinance. It also omits reference to grants of rights in land under the Concession Ordinance or to the

prerogatives of the state government to expropriate land under the Public Lands Ordinance and the Land Administration Ordinance.

Land tenures in Ghana under customary law are of various kinds, but in principle restricted to usufructuary rights [Wills 1962].

Ownership of Land

Land in Ghana is communally owned. Except those parcels of land that come under reserve for the purposes of watershed protection or conservation of economic trees, considered as government lands, a high proportion of the cultivable land falls between the two broad groups of institutional chieftaincy and clanship.

In southern Ghana, the portion of the land falling under chieftaincy is vested in the "stool," the symbol of traditional authority. These parcels of land are referred to as stool lands. Subject to the consent of the "elders" of the stool, the stool lands are expropriated by the chief, the occupant of the stool. Revenues accruing from the expropriations in the way of rents and royalties are used mainly for supporting and maintaining the chieftaincy. The clan lands are vested in the heads of the individual clans and are communally owned by the several members of the individual clans. In the pastoral, northern region, the whole land is vested in the "skin," the symbol of traditional

authority, with the tribal chief, the occupant of the "skin," holding the land in trust for the use of all members of the tribal group.

The Rights of Use of Land

All lands come under a usufruct system. The chief, with the consent of the "elders of the stool" have the right to lease parts of the stool or skin lands on short-term basis, but he has no right to sell them. "Immigrant farmers" may secure farmland either from the chief or the head of the clan by first paying a customary "drink" and then a verbal agreement to payment of some rent, a fixed amount of cash. A tenant farmer may also secure farmland by a proportionate sharecropping agreement. Such agreements are not legally contracted but verbally made so that the tenant farmer may be evicted without any prior notice. Perennial crops do not form part of the cropping pattern under the tenancy system since tenant farmers have only short leasehold rights.

Members of a clan or a tribe have the right of use of parcels of the communal land or to graze livestock on the common grazing grounds. Individuals, however, have no right to dispose of any parcel of the communal land by way of sale. The right to a particular parcel of land by individuals is acquired by who first clears the land and breaks the ground. He does not own the land; he only

occupies a portion of it which has come to him from his ancestors. He does own the products of his own labor on the land and can dispose of them as he pleases, but he has no right to sell the land or to determine which of his descendants should get the major share. Such an acquired, "developed" land is transferable by matrilinear system of inheritance to the legitimate members of the clan or tribe. It must be shared equitably among the beneficiaries. All this is prescribed by rigid traditional rules of inheritance.

The land under the usufruct system is subject to fragmentation due to subdivision of parcels of land as the membership of the clan, an extended matrilinear system, expands. Beneficiaries must share equally bad and good land, and hence individual members of the clan may hold a number of small holdings scattered at distant locations.

Effect of the Land Tenure System on Agricultural Productivity

Three categories of farmers may be identified under the usufruct tenure system, each operating under a different set of problems. These are the small tenant-farmer group which operates under a sharecropping system; the tenant-farmer group which operates under a fixed cash-rent system; and the "owner-operator" group with only the right of use of the land. Each of these groups operates under conditions which militate against high agricultural productivity and hence increased per capita agricultural output.

Agricultural productivity under the three categories of farmers may be considered in terms of the size of farm operation (measured in terms of land acreage), the intensity of farm operation (measured in terms of the amount of capital inputs used per unit farm), and the amount of investment undertaken in the land improvement and development.

Size of Farm Operation

The farm size is basically limited to a small size under the usufruct system which gives rise to fragmentation of the farm holding. A farmer may thus have a number of such small holdings occurring in different distant locations. The small and scattered nature of the farm holdings does not lend itself economically to farm mechanization by individual operators. The size of holding a tenant may operate under the cash rent arrangement is limited by the initial payment of "customary drink" usually in the form of cash payment which may be quite exorbitant.

The size of farm that can be worked by a farm family is further limited by the problems of clearing the land. Land clearing is undertaken by means of manual labor, using simple tools--the cutlass or the hoe and the axe. This invariably limits operations to small size farms--an average of three to five acres in the densely tree-populated forest region, and about five to six acres in the less tree-populated savannah region. The small size farm may be

worked by a large family labor force of about four or five adults and children. During peak periods of operation, the family labor may be augmented with hired labor to finish an operation in time. The per capita output is low because of the small size of farms worked by a large family labor force.

Intensity of Farm Operation

Production of food crops is predominantly subsistence in nature. Where land is plentiful but with the holdings scattered under the usufruct system, farmers cultivate the land extensively; farming here utilizes the natural fertility of the soil and follows a pattern of "shifting cultivation." Farmers rotate the land instead of crops. Under shifting cultivation system, a fresh piece of land is cleared each year and planted to an annual or biennial food crop. When the crop is harvested the farmland is abandoned. The land is allowed to fallow under bush vegetation for a period ranging between five and seven years in the forest region and between three and five years in the savannah region, for the soil to regain the natural fertility.

The fallow periods are shorter in areas where there is a high population pressure on the land. Crop yields in these areas become progressively lower with the frequent use of farmlands at short intervals of cultivation.

Farmers in the system produce mainly to meet subsistence requirements; farming here is a way of life rather than a business. Farmers have no incentive to use such production inputs as fertilizers and improved seeds and in controlling pests and diseases or effectively controlling weeds, all of which affect crop yields adversely.

The major problem arising from the shifting cultivation is the high cost of clearing a fresh parcel of land each year for a new farm which is to be abandoned after a period too short to amortize the clearing cost incurred. Scarce capital is thus wasted with the abandonment of the once cleared land instead of it being used to expand an existing farm as done in settled forms of farming. Clearing cost alone constitutes about 60 percent of the total production cost under the traditional production system [Ministry of Agriculture, Ghana 1968]. It will be about 80 percent with mechanical land clearing if the clearing cost is to be amortized over one season or two of production. The marginal returns to such capital expenditure must invariably fall below the marginal cost of production. The system is thus impoverishing rather than it being productive.

The sharecropping system of land tenure is a disincentive to increasing agricultural productivity via the use of modern production inputs. Farmers are not willing to increase production, a proportionate part of which (usually one-third) will go to a landholder. Use of modern

inputs involves cash expenditures. Farmers have no incentive to spend money on production other than using their own manual labor if all the benefits do not accrue to themselves. Similarly, farmers will not adopt any method or farm practice which takes more than what family labor can cope with.

Land Improvement and Development

Most of the land under tropical conditions await improvement and development for increased production and sustained high productivity. The land development projects must include provision for farm roads, provision for irrigation facilities to bring a great part of the land into production, to facilitate multiple cropping and, above all, to overcome some of the weather hazards and vagrancies. The land improvement measures must consist of soil conservation practices and crop rotation with mixed farming practices to maintain good soil tilth.

Individual farmers under the usufructual rights do not invest in the improvement of the communal land for the benefit of all members of the clan or tribe. They would do so only if individuals have the exclusive use rights over the land. They cannot also practise a crop rotation system with mixed farming because of the small size and the scattered nature of the farm holdings.

Security of Tenancy, Land Improvement, and Capital Formation

One of the most important of a nation's resources in the process of capital formation is the working time. If it is unused there is not only an opportunity foregone but an actual reduction in the capacity of the economy to yield a surplus for further investment. Much of the cost of agricultural production is a time cost. Crops must ripen, animals must mature, and waiting is a principal part of the cost of these processes. A key to the processes of agricultural capital formation lies in the use made of this periodically available labor and leisure.

The farmer, however, must have the incentive to devote his leisure time or income to invest in land improvements and in maintenance of the real property. With insecurity of tenancy under the usufruct system, farmers are not willing to undertake such investments. Tenant farmers do use the land rather in a manner which depletes the land of the natural fertility and leads often to irreversible impairment of the land through soil erosion.

Tenancy period is often too short to make it possible for a tenant farmer to undertake capital investment in farm buildings, fencing, water supply, drainage, soil improvement and conservation which are subject to the process of accretion. Tenant farmers also cannot grow tree crops, which as cash crops or export crops and foreign

exchange earners, do play a significant role in the process of capital formation. Because of the importance of capital investments in farm buildings for some form of animal husbandry, such as poultry keeping, dairying, or hog keeping, the system of land tenure also inhibits a shift from crops to these types of livestock production. Security of expectation on the part of the tenant farmer is crucial for biological forms of capital, for slow maturing enterprises, and for undertakings involving numerous incremental additions made successively over many production cycles. Because the usufruct system of land tenure does not make the rights of use and reward specific to the user of the land, farmers do not make long-term capital investments in agricultural production.

The Farm Credits and Capital Formation under the Land Tenure System

Farm credit requirements, in the form of cash, under the land tenure system are mainly for consumption rather than for productive purposes. These requirements are met frequently by local moneylenders or itinerant merchants who receive back payments in kind—usually in harvested farm products with interest rates ranging between 50 to 100 percent. The merchant moneylenders also serve as the marketing agents who go between the farms and the urban centers, inefficiently performing the marketing service.

Farmers are invariably subject to usury, losing in the process a large proportion of their farm produce in interest payments. They are thus left with very little surplus to sustain them only for part of the year before they take new loans at the beginning of the production season. Subsistence farming has not much surplus to save towards capital formation.

Land Input in
Agricultural Production

As stated earlier, the total land area of Ghana is 91,843 square miles. The vegetation is divided into five physiognomic types [Wills 1962] in the approximate areas of:

High or closed forest	31,760	square miles
Savannah woodland	57,850	" "
Coastal thickets	805	" "
Coastal grassland	905	" "
Strands, lagoon and wasteland .	493	" "

Exclusive of the land for town and country development, over 70 percent of the total land area is cultivable under tree and arable cropping. Out of this cultivable land, only 22 percent is being cultivated under tree and arable crops.

Arable farming follows a traditional system of "shifting cultivation" involving rotation of farmlands. Thus, annual changes in land use involve variation of the crop area farmed within the rotationally cultivated arable farmlands. Increased land cultivation for both arable and

tree cropping, however, is possible through horizontal expansion of the crop area (i.e., by cultivation of fresh parcels of land).

The shifting cultivation system in arable farming consists in rotation of the farmland instead of crops on the farm. The land is cleared and planted in the cropping season. It is farmed in a mixed cropping pattern for a period of one or two years and then abandoned after the crops have been harvested.

Agricultural Labor Force in Ghana

The Nature of the Farm Labor Force

Traditional agriculture of Ghana uses mainly family labor comprising the adult male (the head of the family), the wife and children of the family. Hired labor is required only for short periods of peak farm operation such as land clearing, weed control or crop harvesting.

With the expanding facilities in the rural areas of the country for formal education of the rural youth, the farm family labor force is declining as the youth go to school and withdraw their participation in the farm work. Furthermore, consequent upon the drudgery of, and the low income from the traditional farming occupation, most of the educated youth leave the farm sector for the nonfarm urban sectors in search of "lucrative" jobs which, however, do not

exist at all. These youth move into the cities and live a hard life in the urban slums in the expectation of getting nonfarm employment. Many of them remain unemployed in the absence of employment opportunities and become a social problem.

As a measure to reduce the exodus of rural youth, the government in the early 1960s instituted training programs in agriculture to get the youth to "go back to the land." Farm institutes have been established in the agricultural regions to train rural youth in scientific farming, the objective of this program being to develop a corps of literate farmers who will eventually replace the old illiterate farmers. Graduates from these farm institutes, however, fail to establish in farming and invariably turn to the Ministry of Agriculture for public service employment against the policy objective of the training program.

The Ministry of Agriculture also runs, in a separate department from the agricultural manpower training department, settlement farms to train young primary school leavers in cooperative farming. The objective here also is to develop literate farm operators who would eventually leave the settlement farms to establish and operate commercial farms either as individuals or in cooperative groups. Settlers, however, fail to complete their term of training and leave the settlement to seek nonfarm employment.

Consequent upon the exodus of educated rural youth farm labor force in Ghana is characterized by a high proportion of old (in age), illiterate men and women who have relatively and absolutely low earnings from farming and yet have no opportunities for nonfarm employment. This "residual" farm labor is less capable in physical strength to accomplish much in farm work. It also lacks technical skills in farming and does work on the farm unaided by agricultural technology and, hence, the low productivity of the agricultural labor. Farm work, to the "residual" labor force, is a drudgery, but a way of life.

The Structure of Farm Capital

Working Capital

The traditional system of cultivating arable crops, as explained earlier, consists in land rotation as a means of maintaining the soil fertility. Over the whole of Ghana shifting cultivation is practiced, whereby the fertility of cropping is allowed to rejuvenate by resting the land for a number of years under natural vegetation which springs up when the farmland is abandoned. Under the system the natural vegetation is cleared using the cutlass and the felling axe in the forest areas, or the cutlass and hoe in the savannah areas. The debris is burned on the farm and the crop is planted at stake in a mixed pattern.

The farm cultural practices under the shifting cultivation system consist of the use of local, unimproved seeds as planting materials, control of weeds (usually by manual weeding once during the growing season, using the cutlass or the hoe), "sticking" in the case of yams, crop harvesting and preparation of the harvests for storage or for marketing. The yam sticking uses sticks specially prepared for the purpose. The cutlass is used for harvesting most arable crops except rice, vegetables and fruits which are hand-picked; knives may be used to facilitate hand-picking of rice.

The farm cultural practices for tree crops are the same as for arable crops. A special matchet is used for harvesting cocoa in pods. The cutlass is used for harvesting the oil palm fruits and the coconut in bunches, and kola nuts. Coffee and shea nuts are hand-picked.

Preparation of the harvests for storage or for the market consists essentially of cleaning or processing and/or sundrying. Produce are hand processed without or with some gadgets or equipment to aid the process. Produce are dried on the bare ground or on a "mat" specially prepared such as for cocoa beans. They are carried or handled in locally made containers and stored in local silos or cribs.

The traditional arable crop cultivation does not use purchased inputs such as improved seeds, fertilizers, pesticides and fungicides. There has been an increasing

use of insecticides, however, in the control of insect pests on cocoa and on tobacco (both of them being cash crops). There has also been an increasing use of fertilizers in recent years.

CHAPTER III

THE NATURE OF THE NONCONVENTIONAL AGRICULTURAL FACTORS OF PRODUCTION IN GHANA

By empirical research, it has been shown clearly in the United States that a major fraction of the increase in agricultural output in the postwar period is attributable to changes in the quality of inputs, especially labor, and to expenditures on research [Griliches 1963, 1964]. Research and education affect agricultural output, even though indirectly, by affecting the quality of the conventional factors of production and hence the productivity of farm people.

This chapter is a discussion of research and educational infrastructures that are available in Ghana for servicing agriculture. The discussion primarily deals with agricultural research, extension and educational facilities and defects in the organization and deployment of these facilities. There is also a discussion on the need for an institution of economic research to guide rational production decision making and to provide the basis for rational economic policy in Ghana.

Agricultural Research Infrastructure

Scientific investigations into Ghana's agriculture started in the early 1900s with the establishment of agricultural experiment stations in the agricultural zones of the country. Before the country gained political independence in 1957, it was covered by a number of agricultural stations where experiments in animal and crop husbandry were carried out. The experiment stations, together with a central soil survey station, were the centers of agricultural experimentation to collect basic information and data for guiding scientific agriculture in the country. These stations were under the administration of a Department of Agriculture.

Research in the country's agriculture was given a broader scope of activity after the country's political independence. A scientific service division of the Ministry of Food and Agriculture was established and assigned broader functions of agricultural research. The soil research station with auxiliary laboratory facilities became the headquarters of the Scientific Services Division of the Ministry of Food and Agriculture. This Division combined laboratory research with field experimentation to solve pragmatic problems of the country's agriculture.

Agricultural research was given further impetus in 1961 when the Scientific Services Division of the Ministry of Agriculture was given the status of administrative

autonomy and became an institution of the Ghana Academy of Sciences, lately renamed the Council for Scientific and Industrial Research to embrace also industrial research. The agricultural research division of the Council, together with the agricultural faculties of two universities of the country, has a good number of agricultural research stations strategically located in the agricultural regions of the country. The research stations are well equipped and manned by qualified research staff to undertake both applied and basic research in agriculture.

Inadequate Research

Despite the available agricultural research infrastructure discussed above, research into the country's agriculture, other than the cocoa industry, has been neglected. The gross neglect is partly due to lack of adequate public funds to finance research projects—see Table 1 for the 1970-71 government budget allocation for agricultural development, which also includes funds for research—but in the main, it is due to lack of curiousity and enterprise on the part of research personnel to identify pragmatic problems of the country's agriculture and poor organization of agricultural research.

Neglected Fields of Research

Apart from research in the broad classification of the soils and the general soil fertility carried out under

Table 1. The Government Budget[a] (1970-71 Estimates[b]--cedis '000).

Expenditure	Recurrent	Development
Agriculture	18,895	12,040
Mining and forestry	5,639	5,633
Trade, industry and tourism	1,165	1,308
Construction	11,780	38,770
Transport and communications	8,660	9,135
Education	58,525	7,566
Health	21,956	9,530
Youth and rural development	3,769	2,711
Internal administration	23,312	5,407
General administration	47,887	20,479
Development administration and financing	25,580	14,607
Defense	36,520	9,000
Total	324,400	137,496

a. Culled from Africa South of the Sahara, Europa Publications, Ltd., 1971, p. 341.

b. The figure given in the estimates are at the rate - 2.45 cedis = one pound sterling
= $2.40 U.S.

the British Colonial administration, nothing more is known about the individual broad groups of soils and how best to manage them. Very little is known about the reaction of the soil groups in fertilizer use. The present fertilizer use recommendations are too broadly based and are of little warrantability. More detailed studies of the specific soils regarding the optimum fertilizer requirements for crop production have not been undertaken.

There has been a limited capability for generating and developing new, high-yielding planting materials for food crops, apart from corn and cassava (manihot). An important and potential resource in Ghana is cattle and yet productivity in this area of agriculture is one of the lowest. Basic research to upgrade the local varieties of crops and breeds of livestock is lacking. Adaptive research to introduce new varieties and breeds is also limited.

Little research has been done on ways of carrying cattle through the dry seasons, so that maturation of the animal is very much delayed. Nothing is known about the carrying capacities of the country's grasslands for livestock and little is done about the response of livestock to increased feeding rates or about what optimum rations are.

No research has been done to improve the traditional tools and equipment for agricultural production and processing, or the methods and cultural practices in agricultural production, such as the best crop rotation systems for

settled form of farming, planting of seeds and optimum plant densities, effective and yet most economic weed control, crop harvesting and processing; and little is known about storage of farm produce.

No research is done in the economics of the country's agriculture. Very scanty and inaccurate economic data and information exist for guiding policy decision making in agriculture and for production and marketing. Nothing is known about the size of farm enterprise to provide "adequate" income to farm families and, similarly, nothing is known about what combinations of farm enterprises are most profitable.

The list of neglected areas of agricultural research could go on. The essential point is that capacity for a rapid expansion in agricultural research exists and yet research in agricultural problems in Ghana is very much limited. The research capability and efforts are not as large as they should be to sustain a modern agriculture.

Agricultural Training and Education Infrastructure

In furtherance of the policy objective of developing an agricultural sector capable in its efficiency and sufficiency of sustaining the general economy of the country, there has been tremendous accretive public investments in providing agricultural training and educational facilities. If these facilities would be fully utilized and the graduates

of these training and educational institutions efficiently and effectively deployed for research, extension services and other technical assistance programs to the rural sector, these facilities and skilled manpower could make a significant contribution to development of the country's agriculture.

Agricultural Education

Two of the national universities have each a faculty of agriculture which trains professional agriculturists. The student enrollment of the two faculties has been growing. They both run undergraduate and graduate programs in the various specialized fields of agriculture. The agricultural faculty of the University of Ghana in addition offers training programs for upgrading technical agricultural personnel of the Ministry of Agriculture.

The Ministry of Agriculture has agricultural colleges, farm institutes and farm settlement organizations for manpower development in agriculture. The agricultural colleges run a three-year training program (two years in residential training and one year practical training in the field of agriculture) for high school (secondary school) leavers who come out of the colleges as lower level agricultural technicians. This skilled personnel joins the Ministry of Agriculture as agricultural assistants/ veterinary assistants, or they join the research institutes as research assistants. Both the farm institutes and the

settlement division of the Ministry of Agriculture run training programs for the rural youth, mainly the primary school leavers, to become future scientific farmers.

Extension Services

The need to provide agricultural knowledge and information and to offer training in farming techniques to adult farm people has been felt in the country and is, apparently, being met by the establishment of an extension service unit of the Ministry of Agriculture. The unit, the most vital functional organ of the Ministry, however is ill-equipped and ill-staffed to fulfill its useful purpose.

Capacity for providing extension services to farmers in Ghana is very much limited. With about two million of the total population of the country engaged in farm work and barely five hundred (500) field agents serving on the extension staff, the extension agent/farmer ratio is estimated at 1:4000. At this wide-gap ratio the number of farmers reached with true extension services is rather small. However, investments in research and in the supply of improved seeds, fertilizers and breeding livestock cannot be expected to have much of an impact on agriculture unless the farmer has access to agricultural information, has an increase in agricultural knowledge and skills, and, essentially, a change in values.

The important factors inhibiting development of effective extension services are the mediocrity and niggardliness of the extension field staff and the lack of essential supporting services in the extension setup.

Deficiencies of the Extension Services

The present extension setup was a resuscitation of an orthodox agricultural extension service first established under the British Colonial administration, and which lapsed into a period of political stifling in the first half of the 1960s. The staff was recruited in 1965 mainly from pseudo-agricultural wings, namely, the United Ghana Farmers Council of Cooperatives, the Workers Brigade, and the Young Farmers League, of the political party in government. This recruit had no formal education in extension services and the majority had a low level of education in agriculture. The staff, at the inception of the extension services, was groomed for the extension service work through in-service training. As to be expected, therefore, the original extension field staff has shown deficiencies in extension skills and technical know-how. The original field staff, however, is being withdrawn gradually from the field for retraining in the agricultural training colleges and the universities. Their place is being filled with more qualified staff.

The Ministry of Agriculture comprises a large number of functional divisions, a proliferation which has resulted in the thin spread of the technical staff of the Ministry over the numerous fields of agriculture. The extension service unit of the Ministry, thus, has its niggardly share of the technical personnel which constitutes the extension field staff. Annual additions to the field staff from the training colleges and the universities have been small and its further expansion is being constantly hampered by the government budgetary restrictions.

The extension service unit of the Ministry of Agriculture lacks the vital supporting services of the subject-matter specialists. This group of personnel specialized in the various subject areas of agriculture essentially serve as a link between research workers and the extension field staff. There is, today, a wide gap between research and extension services in Ghana due to the absence of this link. This gap is seen in the apparent lack of agricultural production knowledge and information in the country.

A large body of production knowedge and information, however, exists in technical forms in the files compiled by research workers at the former agriculture experiment stations. It requires this group of subject-matter specialists to extract and simplify the knowledge and information presently in the old research files.

Inadequate Use of Production Technologies

Agriculture in Ghana is traditional and follows a subsistence pattern of cultivation. Production uses traditional inputs of land, labor and low quality forms of capital such as simple tools. Increases in production occur but through increased use of the traditional forms of inputs rather than modern agricultural technologies.

Thus, although expansion of production does occur in the traditional agriculture, the fact that it occurs through an essentially symmetrical expansion of all inputs or through increased input of the already abundant, low quality traditional resources, results in either no increase or a decline in the productivity of resources. In other words, expansion of production in this phase of agriculture is accompanied by declining income and productivity per unit of inputs. When new technologies are introduced as single changes in practice, their effect on productivity is usually very small. Thus, changes by introduction of inorganic fertilizers without improved seed varieties, and without effective weed, disease and pest control, will rarely bring about the major continuous changes in productivity associated with technologically dynamic agriculture.

Unimproved Cultivation Practices and Methods

Sources of Seeds

The seeds for planting are obtained from the previous year's storage, either purchased on the market, taken from a neighbor, or kept by the farmer himself. In either case, the seeds are unimproved, low-yielding, local varieties.

Seed Treatment

The seeds are not chemically treated against disease and pest damage as a means of promoting high percentage seed germination. Seed germination may, therefore, be low.

Plant Densities

Seeds are not planted in lines at any specific seed rates and dimensions but are staggered or planted at stake. This results in uneven stands and low densities of plant population.

Fertilizer Usage

Little (below recommended rates) or no inorganic fertilizers are used for crop production.

Weed Control

Weeds are controlled by manual weeding. Weeding is not done adequately and effectively.

Pest and Disease Control

Pest and disease infestation may or may not be controlled with or without the use of chemicals.

Irrigation

Food crops are grown under rain-fed conditions.

Lack of Integration of Teaching, Research and Education

There is a high degree of complementarity in having agricultural training, research and education integrated, although the three areas do not necessarily have to come under the same administrative organization. The lack of their integration of these areas in Ghana is reducing the effectiveness of individual organization regarding the achievement of the common agricultural development objective and, hence, the payoffs from expenditures on each of them.

In the absence of integration, especially between research and extension education, much of the past research in agriculture has not been relevant to pragmatic problems of the country's agriculture. This is because most research workers have had little appreciation of the problems of farm people. Extension people, on the other hand, have not always been informed of the latest scientific developments on the research front. And teaching has tended to be isolated from the other two functions so that graduates from

the teaching institutions enter the field of agriculture quite new and unfamiliar with the agricultural problems of the country.

CHAPTER IV

OTHER ASPECTS OF THE INFRASTRUCTURE AND SUPPORTS FOR AGRICULTURAL PRODUCTION

This chapter covers a discussion of public institutions and organizations, other than research and education, which operate at the national level and lend support to agricultural production in Ghana. It includes also a discussion of public attitude toward and support of agriculture.

The Ministry of Agriculture

The public organization servicing the agricultural sector is the Ministry of Agriculture. The Ministry has evolved through a series of structural and administrative organization and reorganization. As indicated in Chapter III, the Ministry operated in the pre-independence period as a modest department of the public service organization of the country. The Department of Agriculture, as it was then called, with a director as its head, operated in the field of experimentation and unorganized extension education. It ran and maintained agricultural experiment stations throughout the country and also ran an agricultural training school to produce technical personnel, more particularly, for the cocoa industry.

The post-independence Ministry of Agriculture has expanded in structure and functions, but having stripped from it the function of agricultural research and experimentation. The Ministry in its present organizational setup comprises a secretariat whose function is purely administrative and development planning, and the following divisions which perform technical functions:

1. The Crop Production Division, comprising four functional subdivisions; namely, the Extension Services Unit, the Seed Multiplication Unit, Plant Protection and Quarantine Unit, and the Farm Stores and Supplies Unit.
2. Animal Husbandry Division
3. Animal Health Division
4. Cocoa Division
5. Produce Inspection Division
6. Economics and Statistics Division
7. Training and Manpower Division
8. Agricultural Settlement Division
9. Irrigation and Land Reclamation Division
10. Transport and Mechanization Division
11. State Farms Division
12. The Fisheries Division

The General Character of Administration

Each of the functional divisions have a head, designated as chief, and a deputy chief, both of whom were originally stationed at the national headquarters. Below the chief and his deputy is a hierarchy of field officers ranging from the principal agricultural officer through the senior agricultural officer, agricultural officer, senior technical officer, senior agricultural assistant, agricultural assistant, to the field assistant. Under this administrative hierarchy, development planning, based upon executive policy instructions, is carried out at the national headquarters by the respective divisional heads and their supporting staff.

Development plan implementation is carried out by the field staff under the supervision of the principal and senior agricultural officers at the regional and district levels. As modification of the system, apparently to decentralize development planning and administration, the deputy chiefs are now stationed at the regional headquarters to coordinate the functions of the respective divisions. Development planning, in essence, is still carried out at the national headquarters and the plan instructions are passed down to divisional staff for implementation at the local levels.

Under the present organizational setup of the Ministry, the various functional divisions operate as separate entities and independent of one another, each division given, as it were, to perform specific functions in isolation. This calls for separate administrative personnel for each division at all levels of administration and requires a large number of trained personnel for the divisions in a decentralized development planning. The present setup of the Ministry is characterized by protective institutional bureaucracy. Its major weaknesses are:

1. Proliferation and duplication of functions such as extension services—some of the divisions operate a separate extension service, though unorganized and non-equipped for that function, for their farm clientele.

2. Lack of effective coordination of functions and programs of the divisions at all levels of administration.

3. Lack of personal interest of the public agencies and of participation of private agencies and farmers in the implementation of development plans at local levels.

4. Institutional bureaucracy and "red tapeism" which often contribute to, rather than prevent alienation of the technical staff.

Public Financial Support for Agriculture

Financial support for agricultural development and production has been provided largely by the government.

Budgets for recurrent and development expenditures of the Ministry of Agriculture and the agricultural research division of the Council for Scientific and Industrial Research are provided solely by the government. A substantial amount of financial resources for agricultural development, however, have come to the Ministry of Agriculture in recent years from US/AID as loans in aid.

Budget support through the Ministry and the agricultural research division of the Council for Scientific and Industrial Research for agricultural development, however, has been relatively small. Full data for the period 1957-70 are not available, except for 1970-71 financial year (see Table 1 for the government budget support for the whole economy). The total 1970-71 budget allocation for agricultural development, including agricultural research, represents only 8.7 percent of the total budget for general economic development, even though, as pointed out earlier, agriculture is the dominant sector of the economy that deserves development priority.

The data in Table 1 are somewhat misleading, however. The budget allocation for agriculture is but only a portion of the total allocation for agricultural development. Agriculture benefits from the budget allocations that go for rural development and for feeder road construction in the rural areas. Financial support for agricultural development also comes to agriculture from the government through the

public financial institutions. It is this part of the public financial support, given as farm credits and loans to farm operators, that contributes directly to the agricultural output growth. This portion of the government budget, hitherto, has been niggardly and needs to be increased.

Agricultural Credit Banks

The need for farm credits in the modernization of agriculture and in increasing agricultural productivity was felt soon after the country's political independence. The felt need crystalized in the establishment of investment and credit banks in the first half of the 1960s. The National Investment Bank of Ghana was established in 1963 and the Agricultural Development Bank in 1965. The two banks were established by Acts of Parliament, ostensibly as instruments of economic development. But whereas the National Investment Bank undertakes investment in all sectors of the economy, the Agricultural Development Bank is dedicated to development of the agricultural sector.

The two banks operate strictly on a commercial basis. The distinguishing feature of the two banks, however, is that agriculture should compete with the nonfarm sectors of the economy for investment loans in the National Investment Bank, whereas competition for the Agricultural Development Bank loans is exclusively limited to eligible individuals or groups engaged in agriculture and allied fields.

Any individual, limited liability company, partnership or cooperative group engaged in agriculture and allied fields may be eligible for the banks' loans, but on condition that the economic, technical and market feasibility of the project and the managerial competency of the loan applicant are considered satisfactory by the banks. The banks are more inclined to financing projects in which applicants have already invested or are willing to invest some of their own capital. They take security for every loan. The security may be in the form of immovable property—land and buildings—or chattels—crops and livestock. Securities may also take the form of personal guarantees and indemnities, depending upon the term and type of loan.

The banks operate three types of loans. Short-term loans are granted to enable borrowers to meet the production and marketing costs of crops and are normally repayable within a period not exceeding eighteen months. Medium-term loans are granted for such purposes as the purchase of farm machinery and equipment, livestock, irrigation equipment, and for setting up enterprises allied to agriculture. The loans are normally repayable over a period not exceeding five years; long-term loans are made for new and extensive schemes or improvement of existing schemes such as irrigation projects or tree crop plantations. The loan is repayable over a period not exceeding fifteen years.

The banks, in fixing interest rates chargeable on their loans, take into consideration (a) the bank rate of the Bank of Ghana, (b) rate of interest paid by the bank on borrowed funds, (c) structure of interest rates prevailing in commercial institutions in Ghana, (d) financial prospects of the project to be financed, and (e) length of the term of the loan. Interest is charged at rates ranging from seven to nine percent.

The National Investment Bank has only one office in the national capital, Accra. The Agricultural Development Bank, on the other hand, has a main office in Accra, branch offices in some of the regional headquarters, and farm credit service offices in the districts. The latter is thus able to reach farm operators in the rural areas.

The two banks together provide the farm credit to agriculture at restricted interest rates. The credit facilities of the banks, however, are inadequate and the credit system has been difficult to organize due to the large number of small farmers who are scattered in the rural areas. The mass of the "peasant" farmers of the country do not qualify by the terms and conditions to be fulfilled to secure farm credits from the credit banks. On the other hand, these financial institutions are financially weak and their loan coverage is very much limited. The difficulties and the poor debt collection records of these institutions are such that it is hard for them to fast expand their operations.

It has also been difficult for them to attract extensive banking support from the public. They, therefore, depend largely upon governmentally-supplied funds.

Specific Crop Development Boards

In furtherance of the government policy objectives of providing its people with adequate nutrition and of producing locally the industrial raw materials needed to feed local factories, various specific commodity development boards have been established in the country under the auspices of the Ministry of Agriculture. One of the important policy steps in this direction has been the establishment of the Cotton Development Board, the Fiber and Bast Development Board, and the Grains Development Board.

The purpose of the above establishments is to focus attention and to concentrate efforts and resources in mitigating the institutional, organizational and cultural restraints in the agricultural sector of the country that inhibit increased production of these vital industrial and food crops. Thus, the boards are charged with the responsibility of developing the specific crop areas in all their aspects, including production and marketing of the crops.

The specific commodity development boards stand to succeed in achieving their purpose and in developing these crop areas inasmuch as they will be able to overcome those restraints that are prevalent in the agricultural sector.

Success in development of these crop areas must serve as a model for development of other fields of agricultural enterprise. The establishment of the development boards therefore must not be regarded as an end, but as a means of finding the right solutions to the problems besetting the country's agricultural progress.

The Food Marketing Corporation

Marketing of farm products has been one of the major problems of the country's agriculture, as will be discussed in Chapter VI. Inefficient marketing of farm produce is one factor which accounts for the farmers' reluctance to increase their output of food crops. As a government policy measure to mitigate this problem, the Food Marketing Board was established in the early 1960s on the model of the Ghana Cocoa Marketing Board; the board was later changed into a corporation. The major setbacks of the Food Marketing Corporation have been poor organization, lack of adequate financial support, and lack of equipment and storage facilities to function as an economic entity and to fulfill its useful purpose.

The food marketing organization has been further weakened by the establishment of the Food Distribution Task Force in the early part of 1970. The latter derived its strength from the political support it enjoyed at its inception. At the neglect of the Food Marketing Corporation,

transportation and storage facilities were mobilized in support of the Task Force which was also provided with ample funds to operate, presumably, to stifle the old organization. The Food Marketing Corporation, with its scanty facilities is constrained currently only to market the corn that is imported into the country from the United States under the PL-480.

A Growing Industrial Sector of the Economy

Ghana has an industrial sector that is growing at a relatively faster rate than the agricultural sector. The growing industrial sector can play three important roles in fostering agricultural progress:

A greater fraction of the country's industries depends on agricultural raw materials for their operation. The industrial growth thus creates backward linkage effects, requiring a simultaneous expansion in agricultural production to provide the requisite industrial raw materials.

The growing industrial sector attracts people in the rural sector away from agricultural production. These industrial workers tend to have a greater purchasing power which, coupled with the high income elasticity of demand for food in the developing country, creates an inordinate demand for food. The increased urban demand for food must serve as a market incentive to stimulate local food production.

Perhaps the more important role that the growing industrial sector can play is in the supply of new production inputs that are necessary for modernization of the country's agriculture. The development of chemical industry, including manufacture of fertilizers, should not be too difficult, given the availability of some raw materials and the by-products of the existing petroleum refinery. In addition to this direct contribution to agricultural development, development in the direction of agricultural input manufacture would eliminate the need to import these products which aggravate the already over-strained balance of payments position of the country.

Public Attitude Towards Rural Development

In pursuit of urban industrialization and modernization policies past governments of the country have shown urban bias in providing public utilities and social services, against rural area development. There has been differential quantity and quality of social amenities, namely, water supply, health services, education, access to television, newspapers, etc., in the urban as compared with the rural areas. The consequences of this urban bias for the country's agriculture are that:

1. Out-migration from the rural sector to the urban sector in excess of job opportunities is encouraged.

2. It is difficult to attract and retain qualified personnel to work in the rural areas.

Rural incomes are also far lower than urban incomes in Ghana. Rising real wage rates in the urban sector does not only discourage employment expansion but it also encourages migration from rural to the urban areas. Closing the gap in relative incomes between the two sectors by raising agricultural incomes is a sine-qua-non for alleviating the employment problems in both sectors of the economy.

CHAPTER V

THE NATURE OF INPUT AND OUTPUT MARKETS AND INPUT SUPPLIES, INCLUDING FARM CREDITS, IN GHANA

Inefficiencies and lack of input markets and supplies as well as want of production and consumption credits in the traditional agriculture of Ghana are some of the institutional and organizational restraints that are responsible for mal-allocation of the traditional inputs. They are partly factors which also limit utilization of modern purchased inputs in the country's agricultural production. Similarly, inefficiencies of the agricultural output markets, poor transportation systems and want of consumption credits of farmers are some of the factors which restrain efficient distribution and fuller utilization of agricultural output and, hence, inhibit agricultural output growth. This chapter is devoted to discussion of markets for farm outputs, farm credits and rural indebtedness, markets for farm output and transportation in Ghana.

Production Input Markets

Since the traditional agriculture uses mainly traditional inputs of land and labor and very little or no modern production inputs there are no organized markets for the modern inputs. The markets that exist for such inputs

as improved seeds, fertilizers, farm machinery and chemicals are rather small and supplies are organized by the Ministry of Agriculture

Improved Seed Production and Distribution

A beginning has been made in the supply and use of improved seeds by the establishment of a Seed Multiplication Unit in the Ministry of Agriculture. The Seed Multiplication Unit comprises a section for multiplying the "breeders' seeds" into "foundation seed" lots, an inspectorate and a seed certification section which work with an established Seed Growers Association in finally multiplying the "foundation seeds" for distribution to farmers. Under the present setup of seed production, a selected group of registered farmers with facilities to produce and process seeds is given some technical assistance to grow the "foundation seeds." The seeds are certified, purchased and stored by the Seed Multiplication Unit until the following growing season when they are sold at a subsidized price to farmers for planting.

The setbacks of the present setup have been the delays in the government budget appropriations for the purchase of the growers' seeds, a lack of efficient storage facilities to maintain high seed viability, and deficient seed transportation and distribution to farmers. The long-run objective of the establishment is to hand over the seed storage and seed distribution to the Seed Growers Association

so that the Association will transact directly with farmers while the government provides regulatory services for high quality seed production and distribution to farmers and possibly provide subsidies to farmers.

Fertilizer Supplies

As stated earlier, use of inorganic fertilizers in agricultural production is increasing and the market for the input is gradually expanding. The total tonnage of phosphate, potash and nitrate fertilizers used in the compound form increased steadily from 3,000 tons in 1968 to 8,000 tons in 1970. The growing trend of fertilizer use in agricultural production has been facilitated by a government action in importing and selling fertilizers to farmers at subsidized prices. The setbacks of the government fertilizer program again have been the problems of storage and adequate transportation facilities to cart fertilizers from port of disembarkation to the regional distribution depots. These problems have been identified and need to be overcome in order to enhance the fertilizer consumption buildup.

Supply of Mechanized Services

There is plenty of arable land in the savannah areas of the country which awaits mechanical clearing and preparation to bring those fertile lands into cultivation. Large scale utilization of these areas is impossible under the present traditional land clearing and preparation techniques.

There is, thus, a high need for land clearing and land preparation machinery and equipment to increase the family farm size to an economic unit.

Since the many individual, small farmers cannot afford to own the farm machinery and implements (the present size of the farm unit does not merit individual ownership of farm machinery and equipment, anyway), and since the few commercial farmers cannot own land clearing machinery and implements whose use is specific and limited, mechanized land clearing and land preparation services are provided to farmers on a national scale by the government on a custom-hire basis. The Transport and Mechanization Division of the Ministry of Agriculture maintains and operates mechanization service stations at district level in the savannah areas of the country. The government-operated mechanization services rendered to farmers in the past, however, have been inadequate and inefficient due to poor organization of the services and due to administrative bureaucracy.

There is a little amount of privately organized mechanization services rendered to farmers in the area of farm produce transportation and farmland preparation. A few individual farmers also own farm tractors and implements. The animal-drawn plow was popularly used in northern Ghana in the early 1960s. The bullock plowing, however, was abandoned with the massive introduction of the mechanical plow into the country in the first half of the decade.

Bullock plowing is now being resuscitated in the Upper Region of the country. Training schools are being set up in the districts to train farmers in bullock handling and plowing. The Ministry of Agriculture is to train and supply the draught animals as well as the plow. The Farm Stores and Supplies Unit of the Ministry has also started a program for supplying hand tools, equipment and small, hand-operated, processing machinery to farmers in the rural areas.

Land Input Markets

Land, as discussed earlier, is not a salable resource in Ghana under the usufruct land tenure system. There are, therefore, no organized markets for land as a traditional production input.

Perhaps, the most serious problems associated with supply and utilization of farmland are the insecurity of tenancy and the uncooperative relationship between the landlord (the rentier) and the sharecropping, tenant farmer in sharing the cost of production. The former problem inhibits private investment in the development of the farmland. The latter problem militates against adoption of innovations within the landlord-tenant system for achieving increased agricultural productivity.

Labor Input Markets

Subsistence agriculture as it operates in Ghana uses mainly family labor, as discussed earlier. Hired labor is

required only for short periods of peak farm operations such as manual land clearing, weed control or crop harvesting. There are, therefore, no organized markets for hired farm labor. Information on employment opportunities and supplies of farm labor are passed on by word of mouth. The consequence of this is large discrepancies among wage rates and income levels and poor utilization of farm labor within agriculture and also of general labor between the agricultural and nonfarm sectors.

Farm Credit Supplies

The traditional agriculture in Ghana does not use fixed capital inputs or purchased modern inputs. Credit requirements of farmers are mainly for meeting seasonal consumption needs. No estimates of the demand has been made, but it appears the overall supply is far short of the demand. Most of the farm credit needs of farmers is furnished by local moneylenders and itinerant merchants who charge exorbitant interest rates.

Land constitutes a popular means of providing security for credits obtained from the local moneylenders. The debtor retains ownership, but the creditor obtains possession and use of the land. The agreements provide that profits from the land cover the interest and the debt. The land becomes redeemed at any time upon repayment of the principal by the debtor or his successor. Tree crops as

distinct from the land on which they grow, are frequently the subject of the transactions.

Pledging of land is also a popular way of providing security for debt, especially among cocoa farmers. In such transactions, ownership, possession and use remain with the debtor. The creditor can, however, institute legal proceedings aimed at the sale of the land, if the debt is not repair within the period prescribed in the agreement.

Food crops also serve as security for credits obtained from the itinerant merchants. The farmer takes the credit at the beginning or in the course of the growing season and pledges the crop in the field to the creditor who takes payment in kind at the harvest of the crop. The merchant/creditor thus purchases the farmer's crop and frequently at a price well below the price ruling in the free market.

The sharecropper who is a tenant on a small plot has much in common with the subsistence farmer who is a landholder. He borrows enough, usually from the landlord, to enable him to live while he grows his crop and makes payment in kind by turning over his share of the produce to his creditor/landlord. The system makes the farmer a hired employee repaid in kind.

Agricultural Output Markets

There is considerable internal marketing of food, cash crops, and vegetables throughout the country. The marketing services are performed but inefficiently by a large number of small itinerant merchants who ply betwen the rural markets and product assembly posts and the urban markets.

Marketing efficiency here is considered in terms of the manner in which the marketing services are performed such that the marketing costs are minimized and the price differentials between farm and retail prices are marginal. A condition of high marketing costs with resultant wide marketing margins, thus, implies inefficiency in the marketing system.

About three-quarters of the low income groups in the urban areas of the country spend two-thirds or more of their income on food. As much as half of the consumer's expenditure on food provides assembly, processing (including wastes and losses in transit), and distribution services to bring food from the rural areas to the urban centers. The marketing system is thus characterized by a number of inefficiencies which result in wide marketing margins between urban consumers and rural food producers. These wide price differentials are not generally due so much to the activities of

speculators and traders as to the general lack of efficient storage and transportation facilities and lack of market information.

The high marketing margin in the internal trade of food crops does a poor job of reflecting market information and thus prevents the incentives of the growing urban demand for food from reaching farmers. The marketing system must ensure that the growing urban demand and differentials for output quality are reflected in cash receipts of the farm operators and are not lost enroute. The major features of deficiency of the marketing system are:

1. Abundant supply situation with low food prices in the periods of crop harvests followed shortly by periods of food scarcity with high food prices. The alternating gluts and shortages of food both over time and place result in crop output and food price instability in the country.

2. Inefficient transportation system which also entails large wastes and losses of food in transit.

3. Apparent lack of domestic markets for certain food crops.

4. Existence of a large number of small village merchants and itinerant traders in the output assembly, processing and transportation trade.

5. Existence in the retail trade of a multitude of small specialty merchants who sell small amounts daily.

6. Existence of wide intermarket price differentials and wide marketing margins.

7. A limited market exposure or risk the market channel operators are willing to tolerate.

8. Lack of assurance of market demand for certain agricultural products.

The Nature of the Transportation System

Until the country achieved political independence in 1957 capital investment in road construction was determined by the possibility of mineral exploitation rather than of agricultural resources. Roads were, therefore, confined to the south-west, mineral-rich areas and the area near the sea [Wills 1962].

The railway system grew up in response to mineral exploitation. The western railway line was opened to connect the gold fields with the seaport. It was extended to the central south (Obuasi) partly for the same reason of mineral exploitation and partly for military purposes (in Kumasi). The eastern line was opened, more particularly, in the interest of agriculture, namely, to provide an outlet for the cocoa grown in that area. The central line was opened partly for stimulating cocoa production, partly for mining, and partly for forestry. Production of bananas later developed along the western and central lines, but apart from this and the carriage of cocoa, the railways have had little direct

influence on agricultural land use. Only a small proportion of the transported foodstuffs passes by the railways [Wills 1962].

Roads were developed initially as feeders to the railways, but they were later expanded to the interior as instrument in the economic development of the parts of the country hitherto beyond the reach of improved transportation facilities. Trunk roads were constructed to connect the north to the south and in the south to connect the east to the west.

Greater emphasis, however, has been laid on development and improvement of communication in the country in the post-independence years with the objective of stimulating agricultural production. There has been an extension of the central railway line (from Achiasi to Kotoku) to join the eastern line. There has also been development and improvement of feeder roads in the cocoa and food growing, rural areas.

It is the organization more than the inadequate network of feeder roads that militates against agricultural development. The road transport industry is mainly in the hands of small operators, an operator owning a single vehicle, or two, or three at the most. The vehicle for both goods and passenger traffic is the multi-purpose "mammy lorry" made of a steel chassis and wooden body; by a design of movable planks laid across the sides, the vehicle can be used for both goods and passengers in varying proportions as may be

required by immediate circumstances. In addition to the above there are a few larger, bulk haulage firms which undertake general commodity transportation.

Apart from the movement of cocoa from the collecting centers to the railhead depots and ports and of food from the rural markets to the urban centers, agricultural traffic in the country does not move in bulk but in small consignments. These go together in the same vehicle with passengers so that the agricultural commodity for the local markets and assembly posts become badly bruised or damaged in transit.

The major setback of the transportation system is the delays and sometimes the entire ceasation of traffic during the rainy season. Most feeder roads become muddy and untrafficable for a considerable length of time. Under extreme conditions of heavy rains, bridges and parts of the roads get washed off. It takes a considerable amount of repair work to get the traffic flowing again after the rainy season.

The cost of running and maintaining this type of transport has been high due to the nature of the roads which necessitates a vehicle being written off in three to four years and due to the high repair and fuel costs [Wills 1962].

Poor Transportation as Impediment to Agricultural Development in Ghana

Lack of farm-to-market roads, high cost of transporting farm products from rural areas to urban markets and the long delays and the consequent damage and loss of perishable products in transit, have been serious deterrents to increasing agricultural production in Ghana. Many cultivable farmlands remain inaccessible. Farm produce for the market reach their points of assembly by head loading (porterage) so that farmers can market their harvests only a little at a time. A good portion of the crop, thus, rot on the farms, which would not reach the market because of the lack of a suitable means of transport. Similarly, production inputs, such as fertilizers, reach the farms in single bags, or parts thereof, by head loading. These inputs may sometimes reach the farmers when the growing season is half over.

Agricultural production in Ghana is hampered not only by inaccessibility of farmland or from the failure to bring production inputs to farmers or to move what is produced. Farmers have no incentive to increase production any more than what they can move by head loading. Isolated rural communities remain ignorant of market opportunities and the incentives of the urban market demand, having been cut off the urban markets and with no information reaching them. Communication of these communities with the outside

world come to a halt in the wet seasons. During the dry seasons the roads remain in a poor state; the time and cost of travel are so high as to preclude regular contacts.

CHAPTER VI

THEORETICAL FRAMEWORK OF THE EMPIRICAL ANALYSES

Agricultural production involves transformation of physical resource inputs of land and capital by the human agent resource into agricultural products using available techniques of production. The rationality behind the production decisions (i.e., what to produce, how much to produce, how much of the physical inputs to use or how to produce), under given technical conditions of production, are conditioned by motivation of farmers and by the socio-economic, institutional and organizational matrix of the social system within which farm people as production agents operate. Thus, while usage of the conventional factors of production affect the outcome of the transformation process, the motivational, socioeconomic, institutional and organizational milieu within which production takes place is decisive in the quality as well as optimum allocation and utilization of the conventional factors of production.

This chapter is a discussion of the nature and magnitude of the socioeconomic, institutional, organizational and motivational factors which determine the quality of the

conventional factors of production used in agricultural production, and which condition supplies and utilization of these production inputs.

Sources of Agricultural Production

Figure 3 represents a useful framework within which to analyze the factors that affect agricultural output. Each solid arrow may be regarded as an input-output linkage. These linkages typically involve transfer of both materials and information. The magnitude and rate of transmission of materials and information across the linkage reflect explicit decisions of public agencies associated with agriculture, research administration and scientists, of farmers, marketing agencies, consumers, and others.

As depicted in Figure 3, the production function of the agriculture of a country or region may be represented in the form:

$$Q_t = f \left[\begin{array}{l} \text{Land (quantity, and adjusted for quality),} \\ \text{Labor (quantity, and adjusted for quality),} \\ \text{Capital (quantity, and adjusted for quality),} \\ \text{Weather,} \\ \text{Soil fertility,} \\ \text{Farm roads,} \\ \text{Soil conservation and flood control devices, where necessary,} \\ \text{Dams for irrigation water, where necessary,} \\ \text{Research for agricultural knowledge and technology} \\ \text{Knowledge and skills in agriculture as reflected in managerial capabilities of farm labor.} \end{array} \right]$$

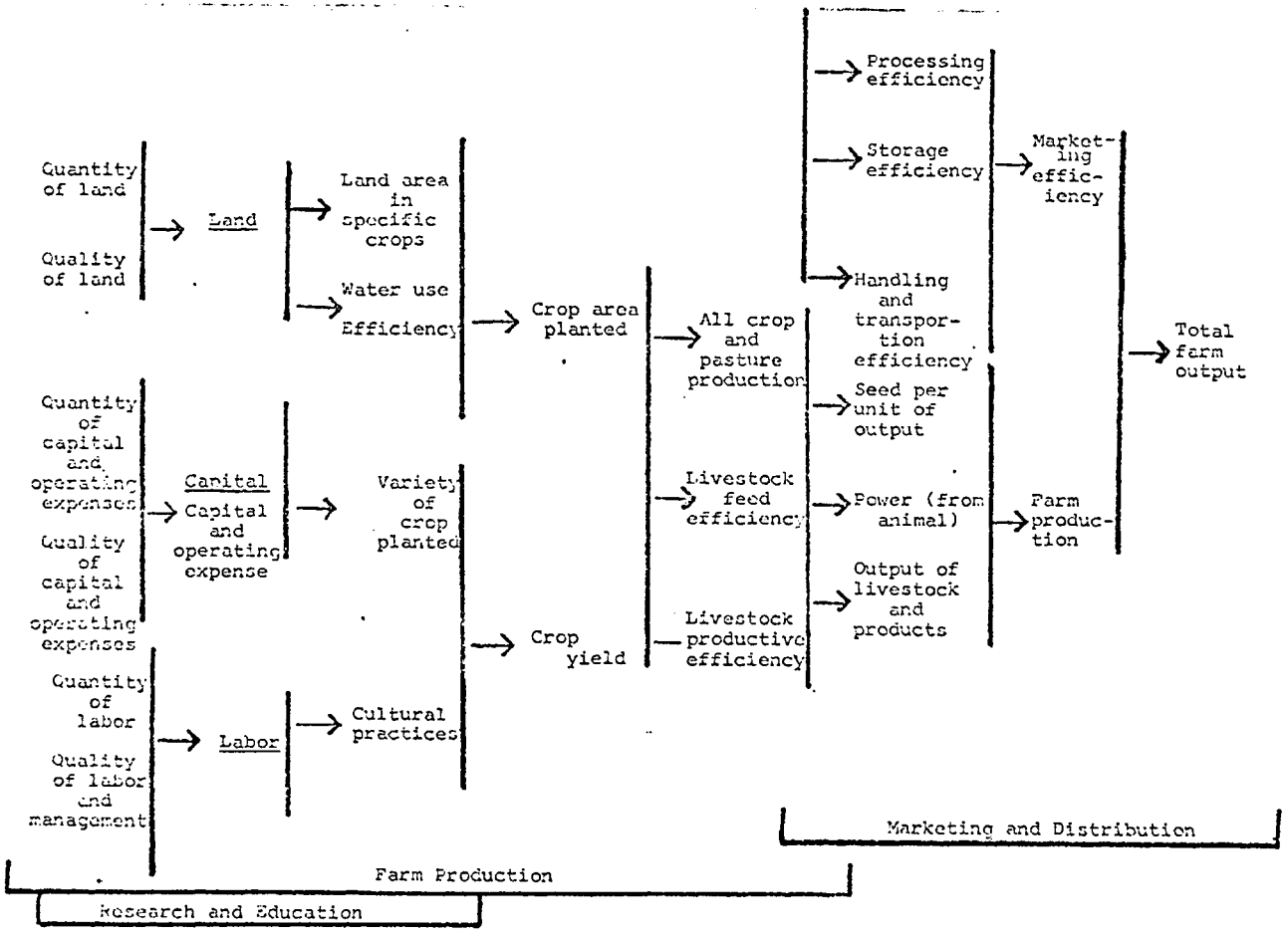

Figure 3. Sources of Agricultural Output Growth.

Source: Adapted from W. W. McPherson, Economic Development of Tropical Agriculture, p. 157.

Q_t is the total agricultural output in point of time. Quality of land consists in its physical and economic capabilities to support commercial agriculture. The quality characteristics of agricultural land are the weather, the terrain, the soil fertility and social overhead, land improvement infrastructure, such as farm roads, soil conservation and flood control devices, and dams. The quality aspect of farmland depends largely upon public investments in the improvement of the land.

Quality of labor is considered in terms of physical capability and technical skills as reflected in managerial ability of farm labor. Quality of farm labor is dependent upon the fund of applied knowledge, including the state of technology and diffusion of available knowledge and technology to the farm people. These are a function of public administration and organization for basic and applied research in agricultural sciences and technology and for agricultural education and skill training in (a) technical fields, such as agronomy, soil science and soil conservation, water management, pest and disease control and agricultural engineering, and (b) economics, such as land economics, general farm economics, and farm management.

Quality of capital consists of the embodiment of knowledge of the agricultural sciences and technology in the material capital. This also is a function of public administration and organization for basic and applied

research in the agricultural sciences and technology. Agricultural capital inputs include farm tools, machinery and implements, seeds, fertilizers and pesticides, water, work and breeding animals, fuel and power other than animal power.

Supply and utilization of the above conventional production inputs depend upon a large number of socioeconomic, institutional and organizational factors associated with the agricultural sector. Thus, supply of farm labor is a function of farm labor market organization and the wage of farm labor or the earnings from farm occupation. Supply of farmland is a function of land tenure institution. Similarly, supply of farm capital is a function of local facilities for supply and distribution, the capital input prices and the prices of alternative commodities.

Utilization of farmland, labor and capital inputs in the agricultural production process involves extraordinarily large and dispersed numbers of decision-making units. The actions taken, with respect to the input utilization, as a result of these production agency decisions, depend upon motivations and incentives which characterize the production units as well as the socioeconomic, institutional and organizational milieu within which the production individuals operate. The principal factors affecting utilization of the conventional factors of production by the production units may be classified into categories as follows:

1. Socioeconomic factors:

a. Input prices, including interest rates.

b. Availability of the requisite inputs.

c. Transport, storage, processing and marketing facilities for farm products.

d. Product prices.

e. Taxes, subsidies and quotas.

2. Institutional factors:

a. General government services and policies, including public budget supports, in providing the inputs and in marketing the farm output.

b. Voluntary and statutory, farmers' and governmental organizations for (1) coordinating the input use, (2) economic services such as sales, purchase and credit statutory boards, corporations and private associations and cooperatives.

3. Organizational factors: These include (a) the modes of organization and administration of the public service agencies servicing agriculture, such as extension services, statutory boards and corporations, as well as voluntary associations and cooperatives, and (b) the state of nonfarm, industrial sector of the economy.

4. Cultural and motivational factors: These consist of the following:

a. Social structure, cultural values and dynamics of rural farming communities.

b. Processes of socio-cultural change, barriers and motivations in the innovative sequence, functional harmony or disharmony in society as its constituent parts change.

c. Public administration factors, structure, values, and mode of operation of the bureaucracy.

d. Integration of agricultural institutions, practices and values within the culture and society of the nation.

The Input-Output Relationship

Irma Adelman introduces into her production function the variable U_t, representing the entire socioeconomic, institutional, organizational and motivational factors which determine quality, supply and utilization of the physical production inputs and which affect the agricultural output distribution and, hence, the agricultural output growth.

Thus, production function for a developing agricultural sector in a given time t, may be represented in the form [Adelman 1961, p. 9].

$$Y_t = f\left[L_t, N_t, K_t, S_t, U_t\right].$$

Y_t is the economy's level of agricultural output in time t. L_t is the amount of land employed in time t. N_t is the total employment of farm labor in time t. K_t is the amount of capital employed in time t. S_t denotes quality of land,

labor and capital employed in time t and represents the technical conditions of agriculture, including the weather, natural soil fertility, social overhead infrastructure in the improvement of land, and the state of technology.

The independent variables of the function are functionally interrelated and interacting and, hence, the production function may assume the form of a Cobb-Douglas production function. The output of the agricultural sector in time t may, thus, be written in the form:

$$Q_t = L^a_t \cdot N^b_t \cdot K^c_t \cdot S^d_t \cdot U^e_t \quad \ldots\ldots (1)$$

The exponentials a, b, c, d and e are the output elasticities of land, labor, capital, technical factors and the socio-political factors, respectively. The function is aggregative of the agricultural sector and, hence, the sum of all these exponentials must be unity if the agricultural sector is associated with constant returns and greater than unity if it is associated with increasing returns to physical input usage.

In Ghana, as pointed out and discussed in the preceding four chapters, the agricultural sector is replete of technical deficiencies--the traditional agriculture does not use technology, except the natural endowments and has little of land improvement infrastructure--socioeconomic inefficiencies, institutional and organizational imperfections, and absence of favorable motivations and incentives. In the circumstances, the variable U constitutes restraints,

underlying the maladjustments in the technical conditions of the traditional agriculture and in the use of the conventional factors of production. The restraints, largely exogenous to the agricultural production process, affect the agricultural output indirectly by adversely conditioning the quantity and quality of the physical inputs used in production. Hence, the production function of the traditional agriculture of Ghana, under the prevailing technical conditions, may appropriately be specified in the form:

$$\bar{Q}_t = \bar{S}_t \cdot \bar{L}^{a'}_t \cdot \bar{N}^{b'}_t \cdot \bar{K}^{c'}_t \quad \ldots\ldots\ldots (2)$$

$\bar{Q}$ in the equation denotes a lower level output than otherwise would be possible without the exogenous restraints. $\bar{S}$, $\bar{L}$, $\bar{N}$ and $\bar{K}$ denote maladjustment in the technical conditions and in land, labor and capital input supplies and utilization, respectively, under the prevailing restraints. The exponentials a', b' and c' are the output elasticities of land, labor and capital, respectively, under the restraints.

The Magnitude of the Exogenous Restraints

The existence of exogenous restraints, that inhibit agricultural output growth in Ghana, are manifested in the lack of use of technology and low agricultural skills and in the absence of motivations and incentives in the

traditional agriculture. It is also manifested in the socioeconomic inefficiencies and the institutional and organizational imperfections of the traditional agriculture, discussed in the preceding four chapters. The magnitude of the exogenous restraints can be illustrated empirically, using a hypothetical case in which the restraints have been overcome by improving the socioeconomic, institutional, organizational and motivational milieu within which the agricultural production agents operate.

As stated earlier, the operation of the exogenous restraints in the traditional agriculture of Ghana results in output level lower than otherwise would be possible without the restraints. Thus, in the absence of the restraints the expected output index of dynamic agriculture in a given period of time is greater than the observed output index of the same period under restraints. Define Q^{ℓ}_{ct} as the expected output index of time t and the observed output index, $\overline{Q}^{\ell}_{t}$, of the same period as $\overline{Y}_t / \overline{Y}_o$. $\overline{Y}_t$ and $\overline{Y}_o$ are the outputs, in dollar value, of time t in relation to the base year of production under restraints.

The expected output index of time t is greater than the observed output index of the same period under restraints. The difference between the expected output index and the observed output index in time, multiplied by the output of the base year, $\overline{Y}_o$, measures the part of the output that is

attributable to elimination or abatement of the restraints. Expressed in symbols,

$$Y'_t = Q'_{ct} \cdot \overline{Y}_o - \overline{Q}'_t \cdot \overline{Y}_o \quad \ldots\ldots\ldots (3)$$

And since, $\overline{Q}'_t = \overline{Y}_t / \overline{Y}_o$, equation (3) can be rewritten as,

$$Y'_t = Q'_{ct} \cdot \overline{Y}_o - \overline{Y}_t \quad \ldots\ldots\ldots (4)$$

From equation (4) the output series attributable to overcoming the exogenous restraints by improving the socioeconomic, institutional, organizational and motivational milieu within which the agricultural production takes place, defined as Y'_t, can be calculated.

As pointed out earlier, equation (4) is a hypothetical case since the exogenous restraints still prevail in the traditional agriculture and therefore the expected output index, Q'_{ct}, does not exist. The model, however, symbolizes forces whose role in agricultural development is undoubtedly vital. The importance of the model is that it constitutes an explicit recognition of the fact that long-term agricultural development trends are not determined only by purely economic and technical factors. The model enables the economist to talk about the impact of alterations in the underlying value systems of the agricultural sector, changes in the mode of organization of agriculture and modification of traditional institutions.

CHAPTER VII

EMPIRICAL ANALYSIS OF THE EXISTING CONDITIONS OF GHANA'S AGRICULTURE

The operation of exogenous restraints in the traditional agriculture of Ghana results in maladjustment in the quality of the production inputs and in underemployment of the conventional factors of production. This chapter deals with the nature of agricultural output and input data in Ghana and statistical analysis of the data to identify the inherent weaknesses in the allocation and utilization of the traditional inputs of land and labor and to determine the significance of the traditional capital input in agricultural production. The chapter also covers evaluation and discussions of the results of the statistical analysis and the deductive inferences from the results.

Agricultural Output Data and Construction of the Output Index

A study of the long-term change in agricultural output calls for the measurement of changes in the output in relation to changes in agricultural production inputs over time. Conventionally, the changes in output are measured

by the construction of an output index. The index can be calculated by using the formula,

$$Q'_t = \Sigma Q_n P_n \Big/ \Sigma Q_o P_o.$$

$$N = 1, 2, 3 \ldots\ldots\ldots n$$

In the above formula, Q'_t is the output index in time t. Q_o stands for the physical quantities and P_o the prices of the base period. Q_n stands for the physical quantities and P_n the prices of any period that is to be compared.

The output index thus calculated, however, does not take account of changes in output in monetary terms over time. This error is removed by deflating the series calculated from the above formula using either a Laspeyre's or a Paasche's price index as a deflator. If Laspeyre's price index is used as the deflator the result is:

$$\frac{\Sigma Q_n P_n}{\Sigma Q_o P_o} \Big/ \frac{\Sigma P_n Q_o}{\Sigma P_o Q_o} = \frac{\Sigma Q_n P_n}{\Sigma Q_o P_n}$$

If a Paasche's price index is used as the deflator the result is:

$$\frac{\Sigma Q_n P_n}{\Sigma Q_o P_o} \Big/ \frac{\Sigma P_n Q_n}{\Sigma P_o Q_n} = \frac{\Sigma Q_n P_o}{\Sigma Q_o P_o}$$

The output series in physical terms are available for Ghana for the period under study, but not the price series for the agricultural products selected for the study.

Since the price index is missing, neither a Laspeyre's quantity index nor a Paasche's quantity index can be constructed in the manner shown above. However, with the available data for physical quantities of agricultural products produced within the period under study, the feasible alternative is to aggregate the physical quantities of various agricultural products by using the known farm prices of a particular period as weights [Yhi-Min Ho 1970]. The calculation of the quantity index then takes the form:

$$\Sigma Q_n P' \Big/ \Sigma Q_o P'$$

P' represents the known prices of agricultural products in any time period.

The output series in physical terms and in dollar value, of agricultural products produced in Ghana during the period under study are shown in Tables 2 and 3, respectively. The output index shown in Table 3 is derived according to the above formula with the 1957-59 average output as the base and the 1957-59 average prices received by farmers, expressed in U.S. dollars per metric ton, as the price weights. The prices of agricultural products received by farmers in the three years immediately following the country's attainment of political independence, are assumed to be normal (i.e., without inflation). Hence, the use

Table 2. Production by Commodity of Total Agricultural Output, Average 1957-59, Annual 1959-70.

Commodity	Price Weight	Average 1957-59	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
	(dollars)	(thousand metric tons)												
Rice (paddy)	109	28	29	32	30	32	33	42	32	38	52	65	61	55
Millet	93	91	90	74	71	75	90	94	75	79	93	73	69	56
Sorghum	92	114	90	93	90	95	113	118	94	128	98	83	88	81
Corn	68	214	178	225	270	260	197	204	247	402	343	301	295	284
Pulses	80	35	35	37	40	42	44	45	46	47	48	45	46	46
Cassava	35	675	760	765	994	1,093	1,147	1,176	689	1,171	1,176	914	940	940
Yams	62	1,217	1,380	1,380	1,415	1,556	1,634	1,675	1,720	1,766	1,814	1,800	1,850	1,849
Cocoyams	54	882	615	916	749	822	864	885	909	963	897	977	965	965
Tobacco	800	1	1	1	2	2	2	1	1	1	1	1	1	1
Peanuts (in shell)	80	39	41	49	41	41	41	45	50	50	61	61	65	56
Citrus fruit	95	33	34	35	36	38	39	40	43	42	42	43	44	44
Bananas	43	181	204	204	208	218	227	233	239	245	252	250	255	254
Plantains	18	1,550	1,701	1,701	1,741	1,828	1,884	1,931	1,983	2,037	2,092	2,050	2,100	2,134
Coffee	360	1	2	2	3	2	3	3	6	5	6	5	6	5
Cocoa (beans)	410	264	322	439	416	428	445	563	416	381	422	339	400	415
Shea nuts	30	24	26	25	28	26	33	29	28	29	35	30	30	25
Kola nuts	125	36	37	38	39	42	44	45	46	47	48	49	49	49
Palm oil	128	20	20	22	23	24	25	26	37	37	38	38	40	55
Copra	100	5	4	4	3	2	2	2	2	2	2	2	2	2
Palm kernels	80	11	11	12	12	12	12	14	22	22	23	25	30	35
Meat	550	36	37	41	51	56	58	59	61	63	65	67	66	66
Eggs	600	6	6	7	7	14	15	15	15	15	15	15	15	15

Source: USDA, ERS--Foreign: Indices of Agricultural Production in Africa and the Near East.

Table 3. Value of Total Agricultural Production.[a]

Aggregate Production	Average 1957-59	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
	(thousand dollars at constant prices[b])												
Crops	3,262	3,688	4,368	4,328	4,566	4,740	5,305	4,603	4,843	4,999	4,542	4,845	4,890
Livestock	234	240	268	323	392	409	415	426	437	448	459	284	284
Total agricultural products	3,496	3,928	4,331	4,771	4,767	4,952	5,517	4,800	5,015	5,203	4,701	4,903	4,936
	Output Index (1957-59=100)												
Crops	100	113	134	133	140	145	163	141	148	153	139	149	150
Total agriculture	100	113	133	134	142	148	165	144	151	156	143	149	151

a. Derived from Table 1.

b. Price weights in Table 1 are used.

of the average price of the three-year period takes into account inflationary changes of the output in monetary terms.*

A total of 22 different agricultural products are covered in the output index. They include eight food crops, one vegetable crop, five oil crops, two fruit crops, four cash crops and two animal products. These together constitute about 92 percent of the cultivated crops and livestock production of economic importance in Ghana.

Land Input Data

Under the shifting cultivation system of farming, described in Chapter II, and in the manner of the irregular shape of farms, it is economically not feasible to measure the land area under crop cultivation for any one production year. The crop area can, thus, only be estimated using estimated crop yields and the crop output (in physical value) for the year. The crop yield is estimated by a sample survey of crops in bearing during the production season. The estimates of land input, in terms of crop area consistent with the crop outputs for the production periods under study, using the FAO estimates of crop yields for the respective years, are given in Table 4. The land input index is given in Table 5.

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* The index of agricultural output is shown in Figure 4.

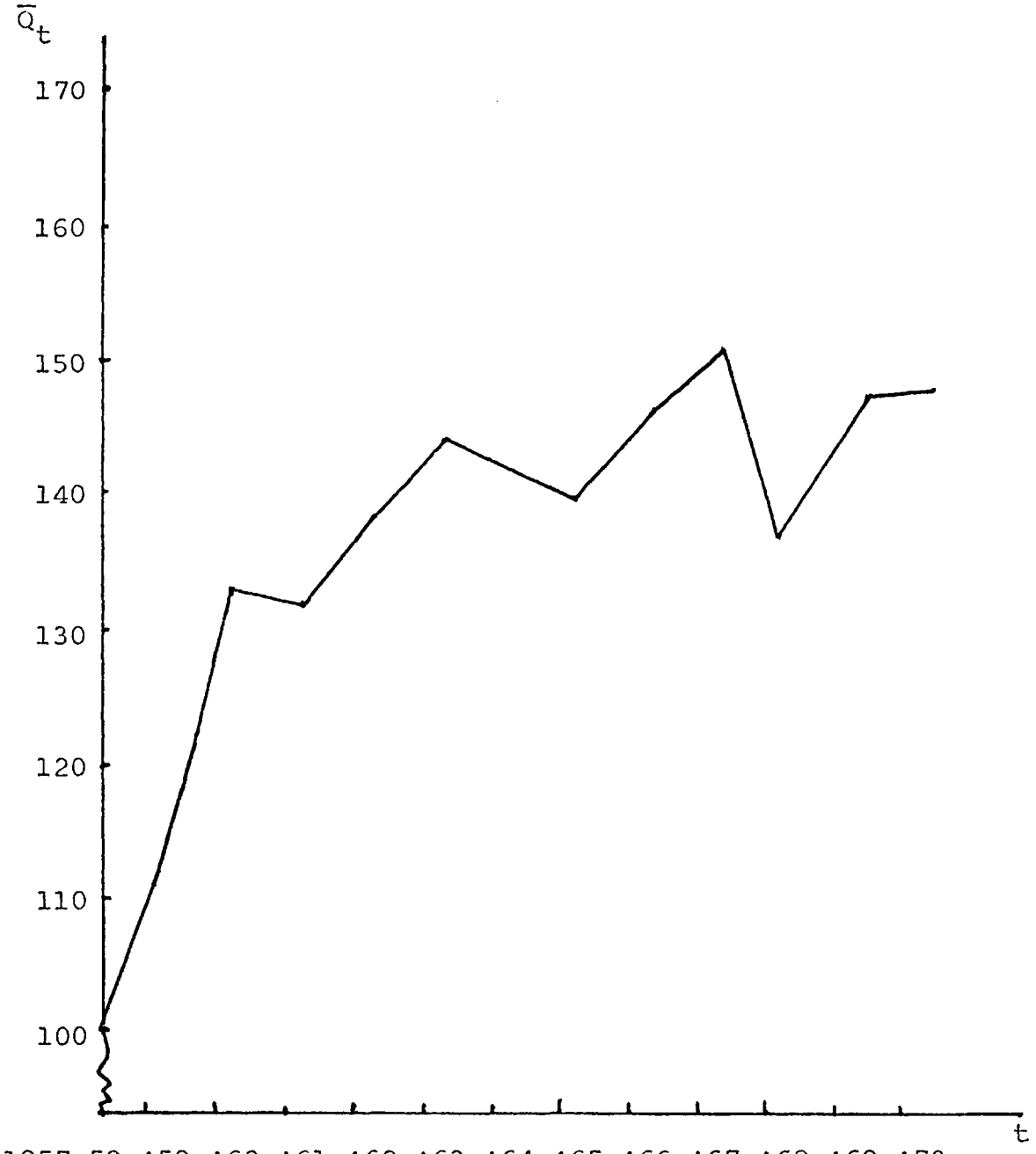

Figure 4. Index of Agricultural Output.

Source: Derived from Table 2.

Table 4. Land Use (Crop Area) in Agricultural Production.

Commodity	Average 1957-59	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
	(thousand hectares)												
Rice	27	28	31	30	31	32	40	31	33	43	45	40	41
Sorghum and millet	327	277	257	248	305	263	269	275	275	301	291	307	285
Corn	211	151	191	229	280	219	240	274	318	295	272	275	265
Pulses	146	146	154	167	131	138	141	144	147	150	141	144	144
Cassava	88	89	90	169	58	159	163	150	186	183	115	146	146
Yams	58	79	79	84	202	212	170	98	87	99	119	120	120
Cocoyams	147	103	153	125	137	144	148	152	161	150	163	161	161
Tobacco	3	3	3	5	5	5	3	3	3	4	3	3	3
Peanuts	53	56	67	60	61	62	67	41	47	61	65	65	65
Citrus fruits	10	11	11	11	12	12	13	13	13	13	13	14	14
Bananas	14	16	16	16	17	18	18	18	19	19	19	20	20
Plantains	111	122	122	124	129	134	138	142	146	149	146	150	152
Coffee	1	1	1	2	1	2	2	4	4	4	4	4	4
Cocoa	98	120	163	154	158	165	188	188	188	141	148	148	154
Shea	9	10	10	11	10	13	11	11	11	14	12	12	10
Oil palm	10	10	11	12	12	13	13	19	19	19	19	20	28
Coconut	2	1	1	1	1	1	1	1	1	1	1	1	1
Kola	13	13	14	14	15	16	16	16	17	17	18	18	18

Source: Table 1, using the crop yields in each year as weights. Figures used are FAO crop-yield estimates each year of the selected period.

Table 5. Land Input Index.

Year	Average 1957-59	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
	(thousand hectares)												
Total land input	1,328	1,236	1,374	1,462	1,565	1,608	1,641	1,580	1,675	1,663	1,594	1,648	1,631
Index (1957-59= 100)	100	93	103	110	118	121	124	119	126	125	120	124	123

Source: Table 4.

Agricultural Labor Input

The measurement of labor input in agricultural production may be considered in terms of the farm services rendered by the farm workers during a given period of time. This calls for a definition of a working day in terms of the number of hours the farm worker works per day. Unfortunately, the farm worker in Ghana, particularly of the family labor force (which forms the core of farm labor supplies) has no set hours for farm work. No such data therefore exist for Ghana.

In the prevailing circumstances, the stock of the actively occupied part of the total population in agriculture may be regarded as being proportional to the labor input in agriculture [Yhi-Min Ho 1970]. Thus, the relative changes in the stock of actively occupied population in agriculture may be taken to be the same as the relative changes in the agricultural labor input. This approach requires information on the size of the country's labor force in agriculture in any particular year of production.

Based on the above assumption, data on the size of the country's population actively engaged in agricultural occupations (i.e., in farm work) for the specific periods can be obtained from census data. The two national censuses carried out in the last decade, the first in 1960 and the second in 1970, provide data on agricultural population. The ratios of farm labor to total population can thus be

calculated for the two census years. The ratios for the inter-census years, 1960-1970, can be interpolated and extrapolated by assuming a constant rate of change of labor force in agriculture. The population of farm labor for each individual year is obtained by multiplying the total population figure for that year by the corresponding ratio of farm labor. The participation of the labor force in agriculture thus calculated is shown in Table 6.

Whether the employment series derived by the above approach is proportional to labor input in agriculture depends necessarily upon the composition of the gainfully occupied population defined in the census enumerations. It is conceivable that a fully occupied main farm operator and a part-time hired farm hand can both be classified as gainfully occupied. The census enumerations used here did not make any such distinction. Nevertheless, farm hired labor is considered to have accounted for only a small share in the total agricultural employment and is assumed to have remained stable over the decade. Indiscriminate treatment of the individual components of the gainfully occupied population does not harm the results so long as the composition is stable over time.

The gainfully occupied population in agriculture increased steadily over the study period (in absolute terms). The ratio of farm labor, however, shows a decreasing rate over the period. This implies a declining labor force, in

Table 6. Participation of Labor Force in Agriculture.

Year	Average 1957-59	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Farm labor ratio	4.20	4.23	4.26	4.29	4.32	4.34	4.37	4.40	4.43	4.45	4.48	4.51	4.54
						1,000 units							
Farm labor force	1,274	1,543	1,579	1,615	1,653	1,693	1,725	1,759	1,793	1,829	1,870	1,885	1,882
Labor input index (1957-59= 100)	100	121	124	127	130	133	135	138	141	144	147	148	148

Source: Derived as explained in the text.

relative sense, of the agricultural sector. The declining agricultural labor force may be attributable to the exodus of youth from the agricultural sector to the urban sectors of the economy. The residual farm labor force includes both male and female farm workers, as well as children above twelve years old (not included in the family labor force by the census enumerations). Women farm workers occupy a large share in the total agricultural labor force (their share in the gainfully occupied population in agriculture is assumed to be stable over the past decade) and contribute, in a large measure, to agricultural production. It is also not uncommon in rural Ghana to have children under fourteen years of age who do not go to school actively participating in agricultural production.

Capital Input Data

Under the traditional agriculture capital input consists of simple tools and equipment named earlier, local seeds for planting, some mechanical, custom-hire services, little amounts of farm chemicals and depreciation on capital investment in the form of tree crops. The capital input, in value terms, per unit area of crop production is a function of the type of capital items used and their unit costs. Per unit farm working capital requirement for crop cultivation, thus, can be obtained by computation of the per unit, crop-area capital cost of production.

The farm capital input index can be constructed if two parallel series of the land areas cultivated of the specific crops and of the per unit area costs are known. The index can be calculated from the formula:

$$K'_t = \frac{\Sigma A_t C_t}{\Sigma A_o C_o}$$

In the above formula, K'_t is the capital input index in time t. A_o stands for the aggregate crop area and C_o the capital cost per unit crop area in the base period. A_t stands for the aggregate crop area and C_t the unit area capital cost at any period that is to be compared. The index so calculated, however, does not take account of possible inflationary changes in the unit area capital costs over time. This error is removed by deflating the index series calculated from the above formula using a Laspeyre's or a Paasche's price index as a deflator.

Unfortunately, no consistent data for prices of the capital input items exist for the period 1957-70. In the circumstances, the capital input index cannot be constructed using either a Laspeyre's or Paasche's index deflator, as discussed above. However, data on land area of crops cultivated within the period are available (Table 4). A feasible alternative then is to aggregate the working capital inputs by using the known per unit area capital input costs of a

particular period as weights. The calculation of the capital input index then takes the form:

$$K'_t = \frac{\Sigma A_t C'}{\Sigma A_t C'}$$

C' is the known per unit area capital cost of production in any period. The capital input index shown in Table 7 is derived according to the above formula, using the 1957-59 average unit area capital cost of production as weights and the crop areas in Table 4 as the aggregate cultivated crop area data. The capital input prices for the period 1957-59 are assumed to be normal (i.e., without inflation). Hence the use of the average price for the three-year period takes account of possible inflationary changes in the unit area capital costs over time.

Framework of the Statistical Analysis for Test of the Hypothesis

In a dynamic condition of the underdeveloped agriculture under the prevailing restraints and with changes in the technical conditions assumed to be neutral (i.e., the rates of substitution of factor inputs are not affected by shifts in the production function) the dynamic production function takes the form:

$$\bar{Q}_t = \bar{S}_{(t)} \cdot \bar{L}^{a'}{}_t \cdot \bar{N}^{b'}{}_t \cdot \bar{K}^{c'}{}_t$$ as in equation (2). Taking the logarithims of both sides of the above

Table 7. The Capital Input and Capital Input Index.[a]

Year	Average 1957-59	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
	(thousand dollars)												
Total capital input	19,048	21,566	22,576	23,962	40,094	41,925	36,800	26,794	26,155	27,568	29,608	30,221	30,170
Index (1957-59= 100)	100	113	119	126	211	220	193	141	137	146	156	159	158

a. Derived as explained in the text.

equation (and differentiating totally with respects to time), one obtains:

$$\text{Log}\,\dot{\bar{Q}} = \text{Log}\dot{\bar{S}} + a'\text{Log}\dot{\bar{L}} + b'\text{Log}\dot{\bar{N}} + c'\text{Log}\dot{\bar{K}} \quad \ldots (5)$$

The dotted variables are complete derivatives of output, land, labor and capital, respectively, with respect to time.

a', b' and c' are defined as $\frac{d\bar{Q}}{d\bar{L}} \cdot \frac{\bar{L}}{\bar{Q}}$, or

$$\frac{MPP_{\bar{L}}}{APP_{\bar{L}}}, \frac{d\bar{Q}}{d\bar{N}} \cdot \frac{\bar{N}}{\bar{Q}}, \text{ or } \frac{MPP_{\bar{N}}}{APP_{\bar{N}}}, \frac{d\bar{Q}}{d\bar{K}} \cdot \frac{\bar{K}}{\bar{Q}}, \frac{MPP_{\bar{K}}}{APP_{\bar{K}}} \cdot$$

$MPP_{\bar{L}}$, $MPP_{\bar{N}}$ and $MPP_{\bar{K}}$ are the marginal physical products of land, labor and capital inputs, respectively, under exogenous restraints. $APP_{\bar{L}}$, $APP_{\bar{N}}$ and $APP_{\bar{K}}$ are the average physical products or productivities of land, labor and capital inputs, respectively, under exogenous restraints. If factors are assumed to be paid their marginal products and the production function is assumed to be homogeneous of degree one, then by Euler's theorem, the output elasticities represent the relative factor shares in the total agricultural output.

By regression estimation of the production function, equation (5), the values of a', b' and c' can be determined and the proportion of the agricultural output variation over time that is associated with variations of the physical production inputs can also be determined. The latter, at

a point in time, represents the part of the agricultural output change that is explained by the physical input usage. The part of the output change that is left unexplained by the physical input usage may be attributable partly to pure statistical error (such as lack of fit) and partly to some random variables of the agricultural sector.

Evaluation of the Statistical Estimates of the Production Function

Recall that production function of the traditional agriculture of Ghana is given by equation (2) of the form:

$$\bar{Q}_t = S_{(t)} \cdot \bar{L}^{a'}{}_t \cdot \bar{N}^{b'}{}_t \cdot \bar{K}^{c'}{}_t$$

Regression estimation of the log-linear functional form of the above, equation (5), using data in Tables 2, 4, 5 and 6, gives aggregate production function of the traditional agriculture, of the Cobb-Douglas form, thus:

$$\bar{Q} = (3{\cdot}1243) \cdot \bar{L}^{1{\cdot}1348} \cdot \bar{N}^{-0{\cdot}3162} \cdot \bar{K}^{-0{\cdot}0125} \quad \ldots(6)$$

F-test of the total regression and residual variances of the estimates shows that variation of the physical inputs significantly explains variation of the agricultural output. The estimation gives the coefficient of estimation, R^2, with respect to land, labor and capital inputs, value as 0·8588. This shows 86 percent of the total variation of

the agricultural output is associated with variation of the physical inputs of land, labor and capital.

The standard error of estimates of the coefficients are 0·32 for a', 0·35 for b' and 0·08 for c'. Student-t tests of significance of the coefficients with eight degrees of freedom at 95 percent level (i.e., $\alpha = 0.05$) indicate that coefficient a' is significantly different from zero, but that coefficients b' and c' are not significantly different from zero. This implies that only the coefficient a' and not b' of c', and hence only the land input, is significant in explaining variation of output of the traditional agriculture. This is further confirmed by partial regression estimates of the production function.

Partial regression estimates of the production function relating the output to land input, other inputs held constant, gives the partial coefficient of estimation, r^2 with respect to land, value as 0·8428. This shows that 84 percent (out of 86 percent) of the agricultural output variation is associated with variation of the land input alone. Stepwise introduction of labor and capital inputs, respectively, into the function shows that variation of labor and of capital inputs, respectively, does not help significantly in explaining variation of the agricultural output. In other words, variations of labor and capital inputs do not contribute significantly to changes of the agricultural output. The above evidence is collaborated by

comparisons of the standard partial regression coefficients, which confirms that a' is most significant in explaining the changes of the total agricultural output.

Discussions

The results of the statistical analysis of the production function indicate some of the factors that are associated with the agricultural output increases. The discussions that follow in this section bring out the strengths and weaknesses (with respect to physical input utilization and techniques of production) of the traditional agriculture.

Land Input

Recall that the production function of the traditional agriculture is specified in the form:

$$\bar{Q}_t = \bar{S}_t \cdot \bar{L}_t^{1.1348} \cdot \bar{N}_t^{-0.3162} \cdot \bar{K}_t^{-0.0125}$$

and that a major proportion of the agricultural output increases is attributable to the land input usage. The high output elasticity of the land input and its high percentage contribution to the agricultural output emphasize the importance of land as a factor of production of the traditional agriculture.

Output elasticity of an input greater than unity implies stage one of the input usage in production--an

increase of the input by one unit results in more than one unit increase in output. It means that land in the aggregate is being used at the "intensive margin"; less land in the aggregate is being utilized in the short-run production relative to farm labor usage in the traditional agriculture. This implies that farm size in crop area per capita farm labor must be small.

According to economic theory, the profit maximizing level of employment of a resource is that level at which the value of the marginal product, MVP, of the resource is equal to the price per unit of the resource input. Stated in symbols,

$$MVP_{\bar{L}} = \hat{P}_{\bar{L}}$$

$$\text{or,} \quad MVP_{\bar{L}} / \hat{P}_{\bar{L}} = 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

$MVP_{\bar{L}}$ represents the marginal value product of land under exogenous restraints. $\hat{P}_{\bar{L}}$ represents average unit price of land (see Table 7 for the aggregate unit price of land). Thus, optimum utilization of land is achieved when the ratio of the marginal value product of land to the unit price of land is equal to unity.

$$\text{Given,} \quad MVP_{\bar{L}} = MPP_{\bar{L}} \times P_y$$

P_y is the average unit price of the agricultural products selected for the study--see Table 1 for the unit prices of

the agricultural products. MPP_L, the marginal physical product of land, is derived by partial differentiation of equation (6) with respect to land input.

From the above data, the ratio of marginal value product of land to its unit price, associated with the traditional agriculture is $\frac{126.02}{105.60} = 1.20$. This shows a marginal value product greater than the unit price of land. This implies that land is not being utilized at the optimum level in the traditional agriculture and that marginal value product of land must decrease to establish the equilibrium, or the optimum point of land input utilization. It means that at constant unit output prices larger amounts of the resource per unit of time must be employed up to the stage where further resource usage causes the marginal physical product of the resource to decline as larger quantities of it are employed.

The implication of the above is that the traditional agriculture uses less than adequate land per unit of time, relative to labor input, and that more land must be opened up. Opening up new land requires construction of more feeder roads. Land utilization and, hence, the question of optimum allocation and utilization of land will be discussed under the land tenure system and land tenure improvement in Ghana.

Labor Input

According to the results of statistical estimation of the production function, of the traditional agriculture, the physical input combinations in the prevailing technical conditions result in a negative output elasticity (i.e., -0.3162) for labor input. A negative output elasticity connotes a negative marginal product of the input and for land it implies that the input is being used at its "extensive margin" relative to other complementary inputs in the short-run production period (i.e., labor input is combined with land and capital in uneconomically large proportions).

According to economic theory, where labor input has a negative marginal product and, hence, a ratio of marginal value product to unit price of labor less than unity, withdrawal of surplus or excess labor from production is called forth. The surplus labor must be withdrawn from production in order to increase the value of marginal product of labor and hence to achieve optimum allocation and employment of agricultural labor.

Despite the statistical evidence of too much labor usage per farm unit in the traditional agriculture, however, observation of the traditional practices and methods of land cultivation shows that the traditional farm labor has rather low capability of accomplishing farm work. Land clearing and land preparation for planting is poorly done; planting is haphazard and weeding of the farm tends to be

poorly done. So also is crop harvesting, resulting in crop damage and heavy crop losses. Hence withdrawal of surplus labor from the farm sector at the present level of farm labor capability, and the present state of the art of cultivation, will result in a further decline of agricultural output and, hence, the productivity of the sector.

Comparative production data for India and Japan, both countries stereotyped as having a high population density and high agricultural labor force, do generally indicate a high productivity for large use of the abundant traditional labor resource in Japan [Mellor 1966, p. 160]. India, by these data, contrasts with Japan in the extent of labor usage. Observation suggests that farming is more "intensively" done in Japan than in India. In Japan, despite the high input of labor per acre, the marginal productivity of labor and the agricultural wage rate are both high by the standards of low income countries [Mellor 1966, p. 160]. The comparative production data for the two countries based on a small sample of farms in one of the principal rice growing areas of India and a similar rice growing area in Japan are shown in Table 8.

It can be seen from Table 8 that labor input per acre is nearly four times as great in Japan as in India. However, in Japan "intensity" of production measured in terms of operating expenses per acre (and also the value of fertilizer used per acre) is nearly eight times as great

Table 8. Comparisons of Farm Input Structure, West Bengal, India, and Kinki District, Japan.

Region	Average size of holding	Labor per holding available for farm work (man equivalent)	Labor available for farm work per acre (man equivalent)	Labor utilization (man equivalent)
	(acres)	(months)	(months)	(months)
India, West Bengal	2.9	24.0	8.0	1.9
Japan, Kinki	3.0	37.0	12.0	7.2

	Labor utilization as percentage of availability	Operating expenses per acre	Value of fertilizer per acre	Gross output per acre
India, West Bengal	23	$17.30	$2.70	$45.80
Japan, Kinki	58	132.00	34.90	448.30

Source: J. W. Mellor, "The Economics of Agricultural Development," Cornell University Press, Ithaca, 1969, p. 160.

(nearly thirteen times as great with fertilizer usage). The value of output in Japan, on the other hand, is some eight times as great as in India. The point is that it is possible to increase productivity of abundant, traditional labor resources through combination of the low productivity resource with modern production inputs and technology. The above comparative observation shows that where agricultural development through technological change occurs without major substitutions of capital for labor, the traditional labor input per unit of land area can be expected to increase substantially.

The comparative observation further shows that differences in the capabilities of farm people are most important in explaining the differences in the amount and the rate of increase of agricultural production. The key factor in explaining the differences in agricultural production in the two countries is the differences in the level of the acquired capabilities of farm labor.

The capabilities of farm labor in Japan have been enhanced by technological innovations (mainly biological and chemical) biased towards saving the production limiting, land resource, relative to abundant farm labor resource. [Hayami and Ruttan 1970]. The farm operations, here consist in better land preparation, the use of high-yielding seeds, use of fertilizers, efficient use of water, effective weeding, pest and crop disease control, effective crop

harvest and seed threshing. The use of items of these farm operations account for the higher per-acre operating expenses in Japan than in India ($132.00 in Japan as against $17.30 in India).

The negative output elasticity of labor input in the country's agriculture indicates a low labor productivity. The low productivity of farm labor coupled with relatively low farm prices for agricultural products gives a low marginal value product of farm labor in agriculture, an economic factor underlying the exodus of educated youth from the farm sector in Ghana. The labor characteristics of the agricultural sector and the phenomenal rural exodus of educated youth may be explained by Figure 5.

Relative to Figure 5, the vertical axis represents wages for labor and the horizontal axis the quantity of (rural) labor employed in the farm sector. P_L is the acquisition value of educated farm labor [Hathaway 1963]. This may be regarded as the return needed to attract educated farm workers into agriculture from the nonfarm sector, or the wage rate necessary to attract hired labor (educated) to farms from employment elsewhere. The assumption here is that general education imbues skills that are somewhat readily transferable between occupations.

P_I is the opportunity cost of illiterate farm labor, lower than the acquisition value of educated labor--if illiterate farmers were employed in the nonfarm sector

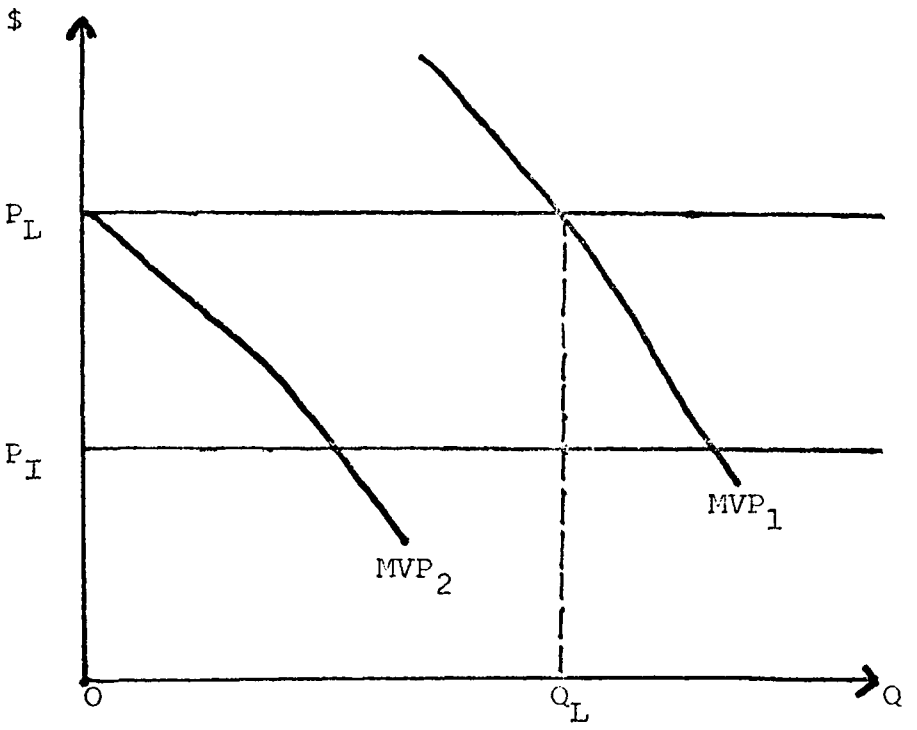

Figure 5. Explanation of Rural Exodus of Educated Youth.

their average earnings would be below that of nonfarm workers; for farm workers who have few transferable skills the alternative to farm employment is often urban unemployment [Tweeten 1970].

Given favorable farm prices and higher productivity of farm labor, the value of marginal product of farm labor may be represented by MVP_1. At this value of labor in the farm sector, Q_L units of educated labor would operate in the farm sector. If the value of marginal product of labor would reduce to MVP_2 because of low labor productivity in agriculture, low prices of farm products, or both, and if farm labor responded strictly to opportunity costs, then out-movement of literate farm labor would begin with the drop of the value of marginal product just below MVP_2. It would, however, be more profitable for illiterate labor to remain in the agricultural sector because its value in use still would exceed its opportunity cost, P_I, in the nonfarm sector. Thus, the employment of illiterate labor in agriculture would not vary despite relative low prices of agricultural products. It means, in order to prevent the out-movement of the rural literate labor, the value of marginal product of labor in agriculture should be raised through increased labor productivity in agriculture by technological innovations as shown in the case of Japan, through increased prices of agricultural products, or both.

Capital Input

Statistical estimation of production function of the traditional agriculture, equation (2), indicates, as discussed earlier in the chapter, that capital input in the agricultural production does not contribute significantly to the agricultural output increase. The capital input has a negative output elasticity (-0.0125). This implies that the present types of capital used in the traditional agriculture have a negative marginal productivity.

As indicated in Chapter II, the traditional agriculture uses poor quality capital inputs. These consist of simple farm tools (the cutlass, hoe, axe and the harvesting machete for cocoa, to mention some of them), local unimproved planting materials from local sources, and simple equipment and devices for processing and handling the farm produce. The traditional agriculture does not use modern capital inputs such as fertilizers, improved seeds and farm chemicals for weed, pest and disease control (except in cocoa and tobacco production where some fertilizers and insecticides are used). The farm capital investments are such as made in the establishment of tree crops and in purchasing breeding livestock. Thus, for the traditional agriculture, a negative marginal productivity of capital input collaborates the observation that the quality of capital input of the agricultural production is rather low.

The quantity of material capital used in production, in the case of traditional agriculture of Ghana, does not matter significantly in explaining the contribution of traditional capital to output increase; it is the quality of material capital that has substantial importance.

As shown in the case of Japan, land as a limiting factor of production and labor as abundant traditional production input have not been important as sources of growth but modern factors of production. The high productivity of farm labor is attributed to the use of modern capital inputs. The quality of such capital inputs depends upon the extent to which the material capital embodies the knowledge of agricultural sciences (i.e., agricultural technology).

The United States may be cited to illustrate the use of capital input in agricultural production. In the United States, major changes in the structure of farm inputs have included a shift from inputs of farm origin such as operator-owned real estate, family labor and other capital inputs, to purchased modern inputs of nonfarm origin (see Table 9).

Since the volume of farm real estate has remained nearly stable in the United States, the major adjustments have been substitution of fertilizers, machinery and other capital inputs (seeds, feed and livestock), purchased from the nonfarm sector, for farm labor. The total dollar volume of all farm production inputs has remained nearly

Table 9. Index Numbers of Total Farm Inputs and Inputs in Major Subgroups, United States, Selected Years, 1910-65.

Year	Total Inputs: All	Total Inputs: Non-purchased[a]	Total Inputs: Purchased[b]	Farm labor	Farm real estate	Mechanical power and machinery	Fertilizer and liming material	Feed, seed and livestock purchased
				(1957-59 = 100)				
1910	82	162	44	212	88	20	12	16
1920	93	174	55	226	92	32	16	23
1930	97	170	62	216	91	40	21	26
1940	97	142	72	192	92	42	28	45
1950	101	119	91	142	97	86	68	72
1960	101	96	103	92	100	100	110	109
1965	103	86	113	75	100	101	163	124

a. Includes operator and unpaid family labor, operator-owner real estate, and other capital inputs.

b. Includes all inputs other than non-purchased inputs.

Source: Culled from L. Tweeten, Foundations of Farm Policy, University of Nebraska Press, 1970, p. 236.

stable since 1942, but because a given dollar volume of purchased inputs was more productive than a given dollar volume of farm labor which was replaced, output increased 40 percent from 1942 to 1965 [Tweeten 1970]. Total inputs increased 3 percent and output per unit of all farm inputs increased 37 percent, or 1.4 percent per year.

The Unexplained Output Variation

As shown earlier in the chapter, 86 percent of the total variation of the agricultural output is associated with variation of the conventional factors of production—land, labor and capital. The proportion of the output variation (i.e., 14 percent) that is left unexplained by the physical input usage in the production process may be attributable partly to pure statistical error (such as statistical lack of fit), and partly to some random variables, (or to the effect of technical conditions of the traditional agriculture on the agricultural output).

Technical conditions of agriculture consist of those factors that bear upon the output by affecting the yield in the production process. They include the weather and the natural soil fertility, as well as technology and the fund of acquired technical skills of farm people. The technical conditions of agriculture of Ghana consist predominantly of the weather and the natural soil fertility, since the traditional agriculture is devoid of technology

and technical skills, as discussed in Chapter III. The weather and the natural soil fertility are the predominant factors that affect the crop yield in Ghana. Hence, changes of the agricultural output that is associated with changes of the technical conditions of the traditional agriculture can be attributed to the random variation of the weather and natural soil fertility of the country.

The Effects of Weather and Natural Soil Fertility on the Agricultural Output

Changes in output (brought about by changes in the weather and natural soil fertility) are measured in terms of output index. In the absence of technical change the aggregate input index defines and indicates the expected output changes [Yhi-Min Ho 1970]. With a more favorable change in the technical conditions, the observed output index in point of time is greater than the expected output index, and vice versa, with an unfavorable technical change.

Define the aggregate input index, $\bar{I}_t$ (under exogenous restraints), as the expected output index. Also recall that the observed output index, $\bar{Q}'_t$ (under exogenous restraints) is given as $\bar{Y}_t/\bar{Y}_o$. Then, with a technical change, the difference between the observed output index and the expected output index in a given time, t, multiplied by the output, $\bar{Y}_o$, of the base year, measures (in dollar value) the part of the output change that is attributable to the

change in technical conditions. This is the part of the output change (other than that due to pure statistical error) that is left unexplained by the use of conventional inputs in the production process. Expressed in symbols,

$$\bar{Y}'_t = \bar{Q}'_t \cdot \bar{Y}_o - \bar{I}_t \cdot \bar{Y}_o \quad \ldots\ldots\ldots (8)$$

and since, $\bar{Q}'_t = \bar{Y}_t \Big/ \bar{Y}_o$, equation (8) can be written as,

$$\bar{Y}'_t = \bar{Y}_t - \bar{I}_t \cdot \bar{Y}_o \quad \ldots\ldots\ldots (9)$$

From equation (9) the output series attributable to changes in the technical conditions, defined as $\bar{Y}'_t$, can be calculated.

In the three-factor input production function, being considered, the aggregate input index, $\bar{I}_t$, of year t in relation to year 0 (the base year) can be derived from the formula [Yhi-Min Ho 1970],

$$\bar{I}_t = \frac{\bar{L}_t^{a''} \cdot \bar{N}_t^{b''} \cdot \bar{K}_t^{c''}}{\bar{L}_o^{a''} \cdot \bar{N}_o^{b''} \cdot \bar{K}_o^{c''}} \quad \ldots\ldots\ldots (10)$$

This method of aggregating inputs implies a Cobb-Douglas log-linear production function. a", b" and c" are weights assigned to the respective inputs and are the factor shares in the total cost of production. The total cost of production includes imputed land rental, imputed labor cost and inputed cost of capital. The factor cost per unit crop area is calculated for each of 19 crops selected for the

study and the aggregate factor cost for the items expressed as a percentage of the total cost of production is taken as the weight of the factor. The factor shares in the total cost of production derived as described above are shown in Table 10.

Specifically, the aggregate input index is given by the formula:

$$\bar{I}_t = \frac{\bar{L}_t^{0.7260} \cdot \bar{N}_t^{0.1569} \cdot \bar{K}_t^{0.1171}}{\bar{L}_o^{0.7260} \cdot \bar{N}_o^{0.1569} \cdot \bar{K}_o^{0.1171}} \quad \ldots\ldots\ldots (11)$$

The aggregate input index compiled from equation (11) is shown in Table 11.

The output series derived from equation (9) of the traditional agriculture attributable to random variation of the weather and natural soil fertility (in seasonal production) is shown in Table 12 and Figure 6. The random variation of the weather other than economic factors to be discussed in the subsequent chapter, is responsible in a large measure for the agricultural output instability of the traditional agriculture in Ghana. The heavy dependence of agriculture upon the natural endowments of the traditional agriculture makes the country's agriculture highly unstable and rather vulnerable.

Table 10. Factor Shares in the Total Cost of Production (Per Hectare) Using 1957-59 Average Input Prices.

Commodity	Land[a]	Labor[b]	Capital[c]	Total cost (U.S. dollars)
Rice (paddy)	37.68	35.43	7.44	80.55
Sorghum and millet	19.32	17.64	7.40	44.36
Corn	22.99	25.71	7.20	55.90
Pulses	6.39	22.70	7.33	36.42
Cassava	89.49	24.69	8.64	122.82
Yams	433.64	21.18	138.40	593.22
Cocoyams	10.80	23.22	6.60	40.62
Tobacco	88.89	52.53	20.55	161.97
Peanuts (in shell)	19.62	29.15	13.28	62.05
Citrus fruits	104.50	11.25	9.25	125.00
Bananas	185.30	26.38	15.12	226.80
Plantains	83.78	26.38	15.12	125.28
Coffee	120.00	16.21	11.07	147.28
Cocoa (beans)	368.16	16.94	11.37	396.47
Shea nuts	26.67	11.96	3.25	41.88
Palm oil	115.38	20.43	10.57	146.38
Copra	85.33	17.50	10.00	112.83
Kola nuts	83.33	11.43	4.00	98.76
Total	1,901.27	410.73	306.59	2,618.59

a. Imputed land rent, based on the "abusa" share-cropping system of land use in Ghana.

b. Farm labor wage/day x number of Mondays for production operations.

c. Imputed aggregate cost of capital used in production.

Table 11. Aggregate Input Index (Base Year, 1957-59).

Year	Aggregate Input Index
1959	99.3
1960	108.1
1961	114.3
1962	128.1
1963	131.8
1964	132.1
1965	124.2
1966	129.6
1967	130.1
1968	127.7
1969	131.3
1970	130.3

Source: Aggregate Input Index formula in the text.

Table 12. Output Series Attributable to Variation of the Technical Conditions, Unit: 1,000,000 Dollars.

Year	Observed output $\bar{Y}_t$ [a]	Expected output $\bar{I}'_t$ [b] . $\bar{Y}_o$ [c]	Unexplained output $\bar{Y}'_t$ (Equation 10)
1959	368.8	323.9	44.9
1960	436.8	352.6	84.2
1961	432.8	372.8	60.0
1962	456.6	417.9	38.7
1963	474.0	429.9	44.1
1964	530.5	430.9	99.6
1965	460.3	405.1	55.2
1966	484.3	422.8	61.5
1967	499.9	424.4	75.5
1968	454.2	416.6	37.6
1969	484.5	428.3	56.2
1970	489.0	425.0	64.0

a. Table 3, the value of agricultural output (crops only).

b. Source of $\bar{I}'_t$; Table 12.

c. $\bar{Y}_o$ = 326.2 million dollars.

Figure 6. Output Fluctuations Due to Random Variation of Weather and Natural Soil Fertility.

Source: Table 14, Unexplained Output. The zero mark is equivalent to the mean unexplained output value of 60.1 million U. S. dollars.

Limitations of the Production Function Model

The production function model used in the analysis is aggregative, in the sense that its variables are aggregates of both quantitative and qualitative elements of the output and input factors. Thus, the dependent variable (the agricultural output) is an aggregate dollar value of a group of 20 agricultural products of no specified quality. Similarly, the independent variables are aggregates of land, labor and capital inputs of no specified qualities. Hence, the output elasticities of the inputs used are aggregative and have no reference to any particular agricultural product.

Ideally, the production function must specify the quality characteristics of the inputs used, since the quality of land, labor and capital are significant when considering differences of output arising from differences in input types used in production. Specification of the quality characteristics of the independent variables, such as presence or absence of farm roads, with respect to land input, skilled or unskilled farm labor, poor or good quality capital, makes it possible to determine the output elasticities of specific variable factors; namely, roads, research and education, of the production function. In the circumstance, the production function model cannot be used for predictions such as the amounts and quality of improvements that should be made in the land or the amounts of

research and education investments that must be undertaken in development of agriculture.

The author is aware of the deficiencies of the model used. They could not be overcome due to lack of relevant data and information for specification of the functional variables. Thus, data on the total number of farms are required for breaking down the aggregate agricultural output to a unit farm aggregate output. "Representative farm" data showing size of farm, classes of land, quantity and quality of labor and capital used, etc., are also needed. These data will make it possible to determine the output per unit farm of a paticular type and size and, hence, enable the economist to talk about scale of farm operation. "Representative farm" data are also needed, especially, under conditions of institutional, organizational and social restraints, for determination of optimum level of input utilization.

CHAPTER VIII

POLICY MEASURES FOR OVERCOMING THE AGRICULTURAL OUTPUT-GROWTH RESTRAINTS

Ghana's inability to achieve sustained and unbounded agricultural output growth in the past one-and-a-half decades and its persistent low level of agricultural productivity are attributed to socioeconomic inefficiencies, institutional and organizational imperfections and to absence of motivations and incentives. These are factors which inhibit the agricultural output growth by restraining proper deployment of available infrastructural facilities for developing technology and for providing agricultural knowledge and skills, and by restraining efficient allocation and employment of conventional factors of production. Agricultural development of the country, therefore, must involve taking policy measures to overcome these factors which restrain agricultural output-growth.

This chapter is devoted to discussion of the policy measures for overcoming the factors that militate against agricultural progress of the country. The policy recommendations outlined in the chapter are based on deductive inferences drawn from the empirical analysis of the existing condition of Ghana's agriculture.

Summary of the Empirical Analysis

Statistical analysis of production function of the traditional agriculture of Ghana shows that 86 percent of the total agricultural output variation is associated with usage of conventional factors of production; namely, land, labor and capital. The high correlation between physical input usage and the agricultural output level implies that any measures that improve quality and promote efficient allocation and utilization of the conventional factors of production will considerably improve the level of agricultural output.

Statistical estimation of the production function also shows that land utilization in Ghana's agriculture is the most significant factor in explaining the agricultural output variation and that land in the aggregate is cultivated at its "intensive margin." The statistical evidence implies that the total amount of land being utilized, relative to labor input, is small. The inference of mal-allocation of agricultural land in Ghana and the need to open up fresh cultivable land is collaborated, empirically, by the ratio of marginal value product of land to its unit price being greater than unity. The need for increased supply and utilization of farmland in Ghana's agriculture calls for improvement of the present land tenure system.

The output elasticity of labor input, according to the result of statistical estimation of the production function, is a negative value. This indicates that farm labor, in the aggregate, is being employed at its "extensive margin." It implies that there is too much labor input per unit area of farmland for efficient utilization of labor input (i.e., in order to increase productivity of farm labor) the implicit surplus farm labor must be withdrawn from agricultural production. It is shown by statistical evidence, however, that the surplus farm labor can be usefully employed in agriculture and its productivity can be raised through technological innovations.

In the peculiar case of traditional agriculture of Ghana, a negative output elasticity of capital input, as shown by statistical estimation of the production function, implies a poor quality capital. The capital input is poor in quality and, as shown by the analysis, does not contribute to variation of the agricultural output. Quality of capital input, therefore, must be improved (by embodiment of technologies) by technological innovations.

The empirical analysis also shows that the traditional agriculture of Ghana is based mainly on the exploitation of the natural endowments; namely, the weather and the natural soil fertility. Both factors in the country are subject to random variation. Hence, the heavy dependence upon them for production makes the country's agricultural output

(by volume) unstable and renders the traditional agriculture highly vulnerable. The output instability and vulnerability of the traditional agriculture can be ameliorated by technological innovations. The objective here is to control the weather vagrancies and to provide a better substitute for the natural conditions in the maintenance of fertility of farmlands, and hence to improve the quality of land input.

Measures for Improving Quality and for Promoting Utilization of the Conventional Factors of Production

As pointed out earlier in the chapter, any measures that improve quality and promote efficient allocation and utilization of the conventional factors of production in Ghana's agriculture will considerably improve the level of agricultural output and hence promote agricultural progress. As shown in Chapters V and VI, the policy measures for improving quality and for promoting supplies and utilization of the conventional factors of production consist in motivating or providing for the motivations which characterize farm people as well as improving the socioeconomic, institutional and organizational matrix within which farm people operate.

Land Reform

The features of the usufructuary system of land tenure which act as a brake on development of Ghana's agriculture are:

1. Too many people living on small, scattered holdings which get smaller with fragmentation of farmlands as the population increases and the size of the farm family becomes enlarged.

2. Extensive use of land in the system of shifting cultivation resulting in high operation costs, low crop yields and, hence, low returns to the farmer.

3. Lack of use of irrigation water with production limited to the use of rainwater in the rainy seasons; there are large stretches of arable land in the savannah zone that are uncultivable for lack of water.

4. Lack of investment in the improvement of the land by owner farmers due to group ownership and by tenant farmers due to insecurity of the land tenure.

5. Low returns to farmers, giving little margin for risk-bearing in adopting new technologies.

6. Subsistence farming with little capacity for growth.

The land reform measures for increasing farm size, in crop area, and intensity of farm operations, and for improving quality of farmlands in Ghana consist in improving the present land tenure system and public investments in land development.

Farm Size and Intensity of Farm Operation

Under the communal, usufruct system, steps should be taken to consolidate the fragmented parcels of land to provide economic size of holdings to farm families. This may mean individual farm families within a clan giving up small parcels of land that are scattered in the different, distant locations for a consolidated piece of land in one location without any displacement of farm families of the clan. Farm families must register such consolidated holdings and thus establish individual permanent property rights over their holdings which must be cultivated on a permanent basis.

The farmer, by the above arrangement, is obliged to stay on one piece of land and to cultivate it intensively. This immediately curtails his sense of affluence in the use of land and his reliance upon natural fertility of the land for the year-to-year production. He must wrestle a living from his limited land resource and is now more likely to adopt those farm practices and techniques that will sustain production even if this production is solely meant to meet his subsistence requirement. Intensive use of the limited land resource requires adequate application of fertilizers with crop rotation to maintain its productive capacity. The farmer is also motivated to use improved planting materials which have a high yield response to fertilizer application.

Development of Farmland

Once farmers have control in the use of specific farmland, they will be more willing and enthusiastic about undertaking development, such as investment of the family labor in fencing to properly demarcate holdings.

The government must undertake such major investment projects as construction of small and medium size dams to bring much of the uncultivated land in the northern region into cultivation. This would both increase the size of existing farms and bring more potential farmers into agricultural production. As part of its land reclamation program, the government should undertake mass land clearing for the large number of small farmers in the mechanizable "derived savannah" and savannah areas and the "Volta Lake area." The cost of clearing for farmers should be charged on a medium-term basis under a farm credit system that will be outlined subsequently.

The farm mechanization and irrigation projects recommended in the northern region brings into focus the need for good soil conservation and soil management measures. The government must institute measures and regulations for mechanized and irrigation farming in the country.

Security of Tenancy and Incentives

The tenancy system can be improved by the government introducing a regulation which gives the tenant farmers security of tenure. The tenancy agreement should be in the form of a legal document which incorporates payment of compensation commensurate with the development investment made to the land in the event of the tenant losing his use rights to the land.

Similarly, the relationship between landowners and tenant farmers under the sharecropping tenancy system should be improved to encourage coming together for agricultural production the capital and land resources of absentee landlords and the managerial ability of tenant farmers. The landlord group could be stimulated to an interest in increased income through innovation and could be educated to see the possibility for such innovation. Indeed, security of tenancy and the willingness on the part of landlords to share in the cost of production should serve to speed the acceptance of innovation within the landowner-tenant system for achieving increased agricultural production.

The Special Importance of Roads and Transportation

Inadequate transport facilities cause much waste and is a direct impediment to development in many parts of Ghana. Poor transportation (including wastes and losses in transit) hits particularly hard at the more distant producing areas and the more bulky and perishable commodities like the plantains.

The major effect of high transportation costs has been to reduce production in the distant areas with the consequent under-utilization of the land resources available in these outlandish parts of the country. In many distant parts of the country agricultural production is limited to the needs of local village markets until low cost transport facilities would make other outlets available. Lack of transport facilities in these areas is primarily responsible for the high marketing costs and for the continued existence of subsistence farming as a way of life of the rural people. A lot of the country's cultivable land lies largely idle because of lack of access roads. These areas, such as the "Affram Plains," await development of farm-to-market roads to bring about a striking increase in grain and yam production.

Road Development and Improvement Policy

It appears agricultural development in Ghana has to be preceded with infrastructural development and improvement of farm-to-market roads. The old feeder roads must be improved and maintained while new ones are built and connected with a network of farm roads.

The idea of providing the rural parts of Ghana with a network of roads sounds overwhelming and connotes a task impossible to accomplish. But Ghana has enough idle resources to undertake feeder and farm road construction. Its surplus labor can be usefully deployed to build feeder roads and rural communities can be encouraged to build farm roads through communal work. A lot of these communities await technical guidance and material assistance to undertake these community development projects. The government, in its rural development program, must give priority attention to road construction. Feeder and farm road systems can be constructed and maintained effectively with the appropriate combination of the available manual labor and such equipment and machinery as may be needed.

Technological Innovations

Other features of the traditional agriculture of Ghana which militate against development of the country's agriculture are:

1. Surplus farm labor.

2. Poor quality capital input.

3. Low productivity of farm labor and capital.

4. Residual farm labor of illiterate adult farmers, with rural exodus of the educated youth.

5. Heavy dependence of agricultural production on the weather and natural soil fertility.

As noted earlier in the chapter, the surplus, low productivity labor of the traditional agriculture must be combined with high quality, modern production inputs in order to raise productivity of the farm labor. The labor productivity, thus improved, will increase the marginal value product of farm labor (under reasonable farm price policy) sufficient enough to attract and retain educated youth in the farm sector. Furthermore, the agricultural output instability and the high vulnerability of the traditional agriculture, arising from heavy dependence of the country's production on the natural elements, can be ameliorated by systematic introduction of technology, technical knowledge and skills into the country's agriculture. Thus, development policies which should be given high priority are those directed towards technological innovations for raising quality and productivity of human and other resources employed in agricultural production.

Technological innovations consist of improvements in the existing techniques of production and production

inputs through basic research and introduction of new techniques and capital materials into production through adaptive research and education. They are measures which bear directly on making significant shifts in the agricultural production functions. Basically, they involve public investments in developing new technologies and in providing knowledge and improving the human agent through education and training in agricultural skills. Related policies to the above involve development of the institutions and industries which supply the backstopping services and modern production inputs, to be discussed later in the chapter. They also involve motivation of farm people and provision of incentives for adoption of the technological innovations, as well as coordination of all those efforts purported to raising productivity in the agricultural sector.

Strengthening Agricultural Research

As stated above, a more important problem in Ghana is the scarcity of innovations in the production of all crops other than cocoa. It is a prime responsibility of agricultural scientists in Ghana to serve the industry for which he is trained. The pragmatic problems of the country's agriculture must define the work to be done. In practice it means applied rather than basic research, the latter being left to the developed countries that can afford it. Thus adaptive research must be done to find

high-yielding, early-maturing substitutes of seeds and breeding livestock for the unimproved planting materials and farm animals. Some improvement should be found for the planting of corn and other crops to give the right plant population in the utilization of land, to facilitate the use of fertilizers, and for effective weed, pest and disease control. A better crop rotation system must be found to replace the present system of land rotation known as the shifting system of cultivation as a means of rejuvenating the soil fertility, and thus to facilitate a settled form of cultivation. Improved methods of crop harvesting must be found to eliminate harvest spoilage and losses. Similarly, methods of combatting disease and pests of crops in storage should be developed to prevent crop damage and losses.

Ghana already has adequate infrastructural facilities for agricultural research. The Agricultural Division of the Ghana Academy of Sciences (the Council of Scientific and Industrial Research) and the agricultural faculties of the local universities together have high quality research stations strategically centered in the agricultural production regions. With the scarce resources that are available for research purposes, care should be taken to avoid duplicity of research efforts and proliferation of a large number of small, ineffective research centers. Rather, an effort should be made to concentrate the limited

funds for research. Specialization among the existing research institutions and within the research units may be necessary while teaming together to find practical solutions to the pressing problems of agriculture. Once research activities are geared to solving the practical problems of agriculture, the financial support for research will have to be greatly increased.

An equally important field of research in agriculture, but woefully neglected in Ghana, is in the area of applied agricultural economics. The significant role of applied economic research is to assist the technologist by providing appropriate analyses of economic forces capable of modification through technical attack and by measuring the efficiencies and weaknesses of technological innovations. Provision should essentially be made for establishment of agricultural economics research unit as part of the Ghana Academy of Sciences to work cooperatively with its Agricultural Research Division.

Strengthening Extension Education and Services

Agricultural production in Ghana is carried out by a large number of adult (male and female) farmers who have had no formal education. The ignorance of these illiterate farmers is one of the major causes of agricultural backwardness of the country. The illiterate Ghanian farmer is

susceptible to embracing production knowledge and adopting technology brought to him through practical education.

Ghana has the beginning of an extension service under the administration of the Ministry of Agriculture. The unit, however, has limited facilities, as noted in Chapter IV, for conducting effective extension services, and hence the number of farmers reached with true extension services is negligibly small. The factors militating against development of effective extension services in the country are the lack of agricultural production and marketing knowledge, the mediocrity and niggardliness of the extension field staff, and the lack of vital supporting services. The extension service unit, in order to fulfill its useful purpose, must have useful agricultural information and practicable agricultural knowledge to extend to farmers. Essentially, it needs a strong backing of research services.

One of the priority needs of the extension services is upgrading the level of training of the field staff both in the agricultural training colleges and training centers as well as the universities. The training colleges and training centers must turn out more graduates, trained in extension work to augment the scant field staff of the Extension Service Unit while, at the same time, creating room unconditionally to re-train the less qualified existing field staff. There is the need to unify all extension services to build one strong extension service

division, staffed with highly qualified personnel, to render effective extension services in all areas of agriculture to farmers. It has been the fashion for the various agencies of the Ministry of Agriculture to run a separate extension service with a handful of untrained staff. This proliferation of function of the extension service in the condition of scarce manpower and physical resources further weakens the effectiveness of extension education in the country.

In addition to supporting research, extension must have strong supporting services and activities which, when effectively carried out and seen in the right perspective, can greatly increase the efficiency of the teaching activities of the extension staff. The supporting services and activities include provision of subject matter specialists, provision of in-service training for field staff, development of audiovisuals, formulation of work plans, preparation of calendar of agricultural events, and planning of work evaluation.

Provision of Subject Matter Specialists

Research findings are written in the form that is highly technical for the extension field agents to understand and utilize and the results are in the form that is not readily applicable to the local farming conditions. Extension service must therefore have on the staff

specialists who are trained in subject areas of agriculture and who can translate research findings into a form that can be utilized by farmers and who can further conduct field trails of research results. The subject matter specialists thus keep field staff informed of new developments in both agricultural science and marketing trends. They must be available to field agents on call to help diagnose new problems and send these problems for their solution through research. They must also participate in the in-service training of extension agents. They, in these ways, serve as a two-way link between the extension field staff and research workers.

The absence of the subject matter specialist staff in the extension service in Ghana has created a wide gap between extension service and agricultural research. A lot of research results obtained at the former agricultural experiment stations are locked up in files being kept in the Agriculture Ministry secretariat. It would take a staff of subject matter specialists to harness these useful sources of agricultural knowledge by editing and field trials to provide information for extension services during the interim period.

As a priority need, the Ministry of Agriculture must endeavor to provide incentives for qualified specialists to join and remain on the extension staff. It calls for a reconciliation of the service conditions between the

Agriculture Ministry and the institutions of higher education and research which have the need for these same specialists. Once the conditions of service are equalized, the Ministry should overcome the fear of losing its trained personnel to the competitive institutions any more. It should then embark upon a program of training in specialist areas. It must be realized that research, education and extension are vital instruments of agricultural development. Their individual roles in the development process are complementary. A deficiency in any one of the three institutions therefore will mar the contribution of the others to agricultural progress. An effort should essentially be made to avoid lopsidedness in the allocation of resources to these three branches in furtherance of the national agricultural development objectives.

Coordination of Teaching, Research and Extension Services

In Ghana, agricultural education in the universities, research by the agricultural division of the National Research Council, and extension by the Ministry of Agriculture are separated and considered quite distinct functions. This separation has resulted in alienation among the three institutions, any cooperation as may exist being only on a personal basis. The differences in the atmosphere of functions make the three institutions drift further apart

and tend to keep research and education away from the actual problems and needs of farmers.

In order to gear the efforts of research, education and extension to achieving their common goal, an institution of a high-powered agricultural research council must be established. The serving members of the council must come from the agricultural faculties of the universities, the agricultural research division of the National Research Council, the Ministry of Agriculture, and the agricultural community. It must have an appointed executive secretary. The function of the council would be to formulate and coordinate agricultural research, education and extension programs, while leaving the directorship of the program implementation to the respective administration of the three institutions. In order not to duplicate the function of the existing National Research Council in the field of agriculture, its agricultural division should be reconstituted into "agricultural research services" under the administration of the Agricultural Research, Education and Extension Council.

Under the above organization, it would be possible to coordinate the efforts of the three institutions, to limit waste of time and scarce resources and to redefine and reallocate activities to the three institutions. It would also be possible to station subject matter specialists in the agricultural research stations to keep

abreast of their profession and effectively serve as the link between research and extension.

Provision of Backstopping Materials and Services for Technological Innovations

The essence of technological change in agricultural production is the adoption of new or high quality inputs in the production process, such as the use of improved farm machinery and equipment, use of superior quality seeds and planting materials, and the use of fertilizers, insecticides, weedicides and fungicides. The primary phase of the adoption process consists in getting farmers to accept the use of these modern production inputs. The second phase that is backstopping to the acceptance phase consists essentially in making the inputs readily and adequately available for the use of the farmers and making it financially possible for them to purchase these inputs. Some of the new inputs have to be created and supplied to farmers in sufficient quantities at the right time of production, in the right place, and at reasonably low prices. Others may have to be imported, but to the specifications of local needs.

Improved Seed Production and Distribution

As far as possible, the Seed Growers Association should be encouraged to take over the seed storage

and distribution. The Association must be helped to establish a private commercial enterprise to be funded by a commercial bank. The seed company should then set up regional and district seed storage and distribution centers, to be serviced initially by the technical staff of the Seed Multiplication Unit of the Ministry of Agriculture.

The government services to the seed company should initially include supplies of "foundation seeds" to the Association, supervision of field cultivation, processing and storage of certified seeds by the Association. These services must be rendered in enforcement of government seed regulations and seed laws and in helping the Seed Growers Association to observe and maintain high quality seed production standards.

Farm Tools, Machinery and Equipment

The use of the cutlass and felling axe in land clearing and land preparation makes it impossible for human labor to farm large acreages. There is so high a demand for labor during these peak periods of land clearing and land preparation, farm wages become very high. This coupled with the drudgery of manual land clearing limits the size of the family farm to a few acres per any growing season. The use of land clearing and preparation machines and equipment during these periods would have a minimal effect

on unemployment and would make it possible to increase several times the acreage worked per farm family.

The present method of land clearing and land preparation--a lot of stumps and logs which would not burn are left to lie in the field--makes it impossible also to plant crops in the prescribed plant densities; this affects adversely the crop yields per acre. The field must be clear of all debris in order to plant at the precise crop density. Furthermore, the use of high quality seeds requires efficient ploughing, seed drilling to uniform depth and placing of fertilizers at optimum location in relation to the germinating seeds in order to give the high-yield response. There is, thus, the need for a certain level of agricultural mechanization in Ghana to aid the human muscle, to give farmers greater control over the production environment, and to make it possible to utilize new forms of cultivation and farming of greater acreage per farmer.

Reasonable payoffs are to be expected from farm mechanization relative to its effects on labor unemployment. The payoff must be considered in terms of accomplishing work more quickly, completing farm tasks with more prevision, developing resources not presently being used and accomplishing farm tasks not possible with traditional techniques.

While the private enterprise in farm mechanization is yet to develop, the government services must be increased

in volume and improved in quality to provide large-scale land clearing services on a custom-hire basis for both small- and large-size farmers. Private firms and individuals must also be encouraged to run tractor custom service in land preparation for the many small-size farmers.

Opportunities exist for providing farmers with better tools for planting, weeding the farm, and for harvesting. Adaptive research is needed to develop local tools that are more efficient, cheap, simple to operate and which can be maintained in the village. The existing agricultural engineering company that manufactures farm tools and small machinery and equipment must intensify its engineering efforts in breaking new grounds. Other agricultural engineering companies must be encouraged to establish in order to offer the necessary competition for developing innovational quality farm tools and small hand machines. The areas of innovation that may receive immediate attention are:

bullock-drawn ploughs, planters, and seed drills—these can be produced locally to increase the use of these equipment in the northern part of Ghana where farmers have the knack for handling and keeping bullocks;

harvesting implements—sickles and scythes, little known in Ghana, are efficient for harvesting rice on small-size farms. They could replace straight blade knives and hand-picking of rice heads;

threshing equipment—machines operated by foot pedal (or motor), now used in Japan and Taiwan, are efficient for threshing on small-size farms;

multi-purpose equipment with rubber tires—a French designed form of animal-drawn equipment called the "tropiculture" has been introduced successfully in Senegal.

Fertilizer Supplies

The growing trend in fertilizer use in Ghana has been facilitated by the government action in importing and selling of fertilizers to farmers at subsidized prices. The government should continue its present program to build up fertilizer use in agricultural production. The private sector should then be induced by the demand created to establish a local fertilizer industry.

The setbacks of the government fertilizer program have been the problems of storage and of adequate transport to cart fertilizers from port to the regional distribution depots. These problems have already been identified and must be overcome in order to enhance the fertilizer consumption buildup.

Insecticides, Fungicides and Weedicides

There is a tremendous need for insecticides and fungicides to control pests and diseases on cocoa, food crops and tobacco, both in the field and in storage.

Chemical weed control could be more efficient and more effective than the manual weeding if the appropriate and yet cheaper weedicides could be found.

The firms which hitherto have been dealing in these inputs in Ghana must be encouraged to establish local research and manufacture base from where studies into local problems of pest disease and weed control can be conducted and where the appropriate control chemicals could be developed and produced.

Provision of Farm Credits

The farmer's need for consumption credits and rural usury are the causes of indebtedness of the small farmers. Credit difficulties also lead to exploitation of the small farmers by local moneylenders and itinerant merchants upon whom they depend for their credit needs. Thus, unless the small farmers are emancipated from their indebtedness and made independent of their creditors they will not be in a position to respond favorably to the incentives of high urban demand for food and they are not likely to adopt new technologies.

The policy measures to solve the problems of rural indebtedness and dependence of the small farmer upon the system of usury to meet his credit needs, is to raise the productivity and income of the small farmers. The method consists of an input of technical improvements in a package

program to be backstopped with credits for meeting the consumption and production credit needs of small farmers. It calls for organization of an institution which will guarantee realization of high income by small farmers and which will ensure repayment of the amounts of credit involved.

The organization should comprise a credit unit which holds and operates the credit funds, an extension service unit to be responsible for the technical improvements and the proper use of credits, and a processing and marketing unit through which loans also will be granted and repayments collected. The organization must establish its unit offices in Accra, branch offices in the eight regional headquarters, and sub-offices in the forty agricultural districts. For the purpose of coordination of the functions of the component units of the organization there must be an appointed executive director with his national office in Accra.*

The key importance of such an organization must take precedence over fears as to its costs. The costs are more easily met when marketing of the produce is handled efficiently. It may be necessary initially for the government to cover part or all of the overhead costs which must

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* See Figure 7 for the organizational chart of the Farm Credit Administration.

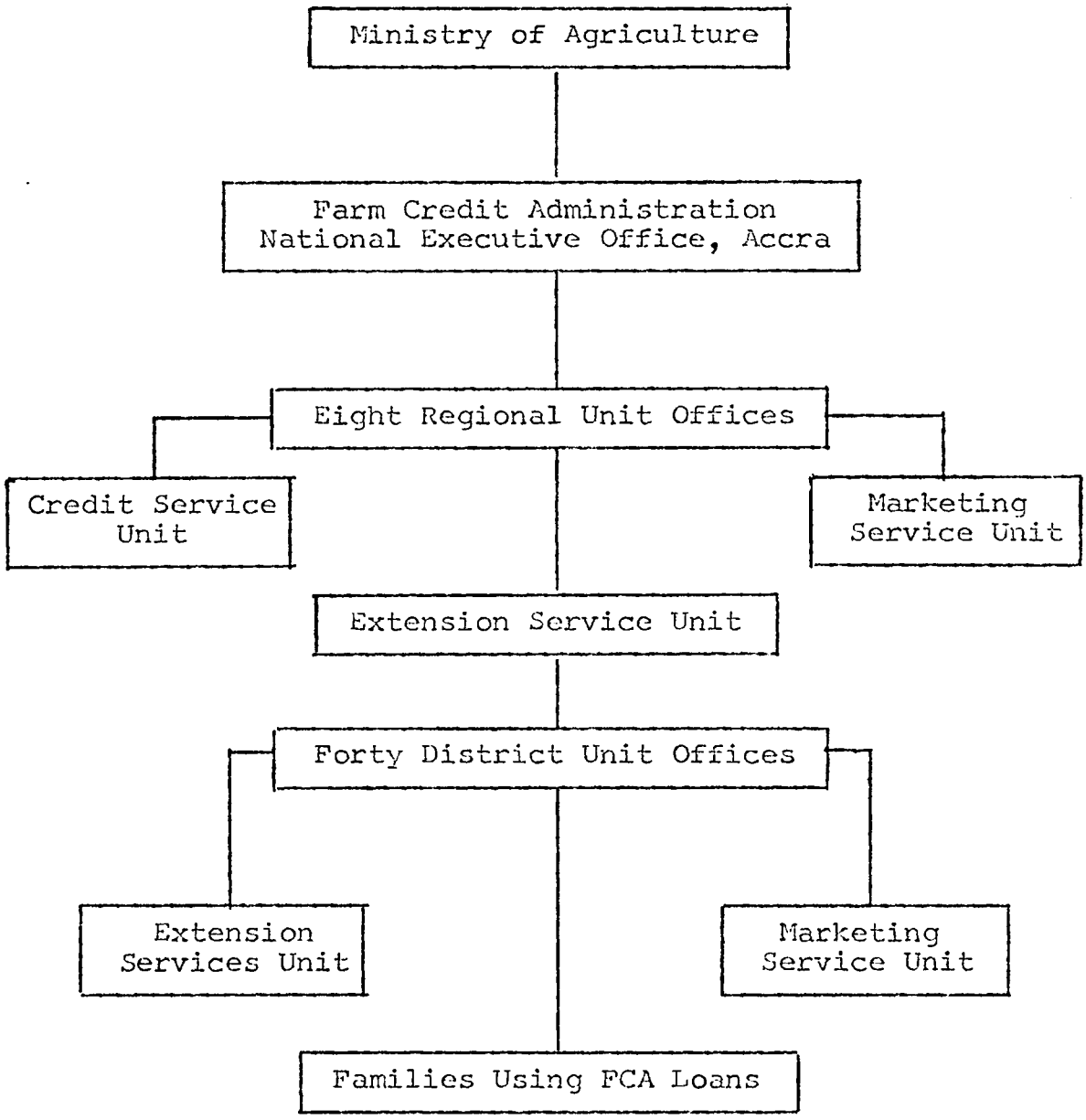

Figure 7. The Organization Chart of Farm Credit Administration.

be regarded as much an integral part of the development as research or extension services.

The Objectives of the Farm Credit Administration

The lending authority of the Farm Credit Administration must involve two main objectives. The first objective must be to strengthen the economic position of individual family farmers by providing supervised credit to the many small farmers who are unable to obtain credit from the commercial lending institutions. This objective includes extension of credit to eligible farmers for those things that will improve the level of agricultural income and living standards. The second objective will be to improve rural communities by extending credits for such items as rural community electrification, rural water and sewer system. The Farm Credit Administration should give loans specifically to those farmers and rural organizations that are unable to obtain credit from other sources on reasonable terms. Borrowers must agree to obtain their credit from other lenders when they reach or regain a position where they can do so.

The Functions of the Farm Credit Administration

The Farm Credit Administration must operate on a revolving fund set up by the government and held in trust by the Agricultural Development Bank in order to minimize

the urge to operate strictly on a commercial basis. The interest rate on loans must be lower than the prevailing market rate, considering the investment as an integral part of the agricultural development investments.

Loan applications should be received through the extension field agents who will also help the farmer applicants to plan the farm project and supervise the use of the loans. Applications should have to be processed expeditiously and the loans granted in good time since there will be no further need for feasibility studies after the credit unit has received the applications on recommendation from the extension agents. Farmer applicants must sign a legal document of obligation to process and market his produce through the marketing unit of the FCA.

The Ghana Food Marketing Corporation should be strengthened in personnel with the necessary managerial competence and integrity, and with complementary staff of product inspectors/buyers, storekeepers and accountants to constitute the marketing unit of the Farmers Credit Administration. The unit should obtain its operating funds from the credit agency (out of the revolving fund). The prerequisite for successful operation of the marketing unit is provision of adequate storage and transport facilities. The farm produce must be purchased and delivered to approved warehouses located throughout the country. Farmers must be

encouraged to provide their own storage facilities on grants of medium or long-term loans, according to the nature of the storage facility.

Insured Loans Program

In addition to the loans operated on the government appropriations, the FCA within its framework could also operate "insured loans" scheme. The objective here is to stimulate the use of private capital, presumably from the commercial banks, in the place of direct government grants. Through the insured loans scheme private lenders can advance loans through the FCA to eligible applicants for a number of different purposes within the functional objectives of the FCA. All loan making and servicing operations are to be handled by the FCA without cost to the lender. Payment of principal and interest (at the going rate charged by the FCA) are to be fully guaranteed by the government.

Economic Incentives for Production

For technological innovations to gain acceptance incentives and various servicing agencies must be improved. A precondition for the acceptance of technological innovations is development of an environment in which the proceeds of increased production go in sufficient part to the farmer decision-maker to provide incentive to him. The factors which provide for motivation of farmers and

which influence their incentives include economic institutions and practices as well as governmental, statutory and voluntary farmers' organizations which service agriculture.

The economic institutions and practices for farmers' motivations and incentives include facilities for producing and distributing new forms of inputs and extending farm credits, discussed earlier in the chapter, and processing and marketing the increased farm output, reasonable farm price policy and subsidies. Provision of the modern inputs as well as their use and marketing of the increased output are largely of organizational nature for which trained manpower is the principal input. This calls for governmental organization for coordinating physical input usage and for diffusing technical knowledge involved in the use of the modern inputs, and statutory and voluntary farmers' organizations for economic services, such as sales, purchase and credit boards, corporations and farmer's associations and cooperatives. Ghana has institutions and organizations which need to be improved or strengthened to provide production incentives to farmers.

Market Reforms

The greatest imperfections in the marketing system appear to be in regard to erratic seasonal price fluctuations arising from lack of storage facilities and from the large spreads in prices among local markets. In regard to

the seasonal price fluctuations the most useful steps are increased storage facilities and buffer stocks creation, government guaranteed minimum prices and, even more important, improved market information concerning current production prospects and stocks. In regard to inter-market price differentials, the key requirement is improved transportation facilities supported by more intensive market reporting. All these are major market reform measures which require government intervention.

A critical step in the process of market reform must take place at the assembly, processing and transportation level, and also at the retail level in the marketing channels. The large number of small specialty merchants who constitute the middlemen between farmers at the supply end and retailers at the demand end of the marketing channels do little to encourage farmers. Crops in the field before harvest are often pledged for cash advances received by farmers from the itinerant merchants. Alternatively, the produce are sold at harvest at very low "take prices" in small lots to merchants who are at the spot with ready cash. There is thus a high exploitation of farmers by these middlemen at the supply end of the marketing channels. Furthermore, because these small merchants are limited in the amount of processing and transport facilities, they cannot offer to buy large quantities of products of uniform quality at stable prices. At the retail level the atomicity

of the trade results in diseconomies of the small scale retailing so that costs do rise with the consumer ending up in paying more for lower quality of food.

What appears to be needed is a few large, multi-product merchants with facilities for processing, handling, transportation and temporary wholesale storage. Private companies and cooperative groups should be encouraged to play their important role. In the absence of these agents the existing gap must be filled by a public marketing organization. The existing marketing organizations, such as the Ghana Food Marketing Corporation and the food distribution "Task Force," should be strengthened in personnel with marketing know-how, in finance and materials, transport and storage facilities to efficiently perform the marketing functions.

The organized agricultural marketing agencies should also be made responsible for breaking the risk barriers which block those products that do not pass through the marketing channels and for which there appears to be no markets. These products are not accepted through the marketing channels, hitherto, because of uncertainty as to the level of the demand relative to supply in the urban markets. There appears to be a lack of information about the marketing conditions of these products and lack of insurance against the market uncertainties. These market defects tend to minimize the marketing risk the small

merchant and retail traders are willing to tolerate, given the stringent limits of their financial resources. When the market risks are removed, or at least reduced, both farmers, as producers, and retailers, as distributors, of food would be more willing to expand their scale of operation.

Increasing the Market Capacity

In addition to establishing domestic marketing channels for new agricultural products, the reinforced Food Marketing Corporation should also be made responsible for conducting export markets for the exportable products in the same way as the Ghana Cocoa Marketing Board handles the foreign marketing of cocoa. Through the Ghana embassies overseas, the Food Marketing Corporation should find possible foreign markets for the country's agricultural products other than cocoa. The country should find markets, at least, with its foreign creditor nations.

There must also be an effort to expand the capacity of the country's markets through diversification of both production and the uses for the agricultural products and through development of means of processing and storage of the products. Adaptive research must be done to introduce new crops of exportable value from other tropical areas of the world. The Ghana Food Research Institute must also

direct attention to finding means of processing raw food products into more refined forms and of storing them to maintain high food quality and to finding more uses and new products for the country's raw agricultural products.

Rational Price Policy

Price policy designed to increase the aggregate of production within the context of a traditional agriculture suffers from three major defects. First, the necessary policies will tend to be inconsistent with other and perhaps more basic goals of development. Secondly, the appropriate devices for affecting price increase may be difficult to organize and administer. Thirdly, even if the desired price policy can be executed, it will tend to be ineffective in raising the aggregate of production. A more modest price policy than increasing the general level of farm prices is one for decreasing uncertainty regarding the level of farm prices through a price stabilization program, namely a government-guaranteed minimum pricing system.

Government Guaranteed Minimum Price

The concept of announcing a fixed price for farm produce before the cropping season begins, in order to stimulate increased production and to avoid exploitation of farmers by private traders, is effectively applied in the cocoa industry. At the beginning of the season the Ghana

Cocoa Marketing Board announces a uniform price for the respective grades of cocoa beans. Farmers are therefore certain about what prices are going to be. The farmer is thus able to sell his cocoa at these prices instead of accepting whatever prices independent, local private buyers may offer. Cocoa production has flourished in Ghana because of the organized marketing system with the built-in guaranteed pricing mechanism which offers price certainty of produce.

The guaranteed minimum price program in the cocoa industry derives its effectiveness from the existence of buying centers widely distributed within reach of farmers throughout the country, organized buying agencies and ample storage facilities. Effective guaranteed price programs also need backstopping facilities for storage and transportation.

Improvement of Administration and Agricultural Staff Motivation

In Ghana, the Ministry of Agriculture is the governmental organization servicing agriculture. As an integral part of the agricultural development process improvement in the administrative machinery of the organization is needed to make for more effective use of both manpower and other resources that are channeled to agriculture by the public sector. Similarly, development of talents by staff training both for the administration of the

agricultural development planning and the plan implementation could make a significant contribution.

Reorganization of Administrative Machinery

The present machinery calls for a reorganization into a decentralized development planning and administration. It involves a merger of some of the existing divisions of the Ministry of Agriculture while laying emphasis on training and extension services as the primary functions of the Ministry in the agricultural development process.

Thus:

1. The Crop Production Division, the Cocoa Division, the Animal Husbandry Division and the Animal Health Division should merge to form the Extension Service Division. The heads of the component units of the Extension Division would become and designated as Chief Subject Matter Specialists. There should be a unit, the Farm Supplies Unit, of the Extension Service Division to provide the requisite backstopping services such as improved seeds and seedlings (including cocoa, oil palm, rubber and citrus), fertilizers, chemicals, farm tools, equipment and materials that cannot be efficiently supplied to farmers by the private sector. This division should be responsible for carrying out extension services to all farmers in all fields of agriculture.

2. The Irrigation and Land Reclamation Division and the Transport and Mechanization Division should merge to form the Farm Mechanization Division, which should be responsible for land development (including land clearing and dam construction, irrigation and reclamation). It should also be responsible for providing custom-hire services of farm machinery to farmers.

3. The Training and Manpower Division should be responsible for the training of all lower grade technical personnel for the various divisions of the Ministry. This should include the training of agricultural assistants, veterinary assistants, produce inspectors, and tractor and farm machinery operators. The farm institute and farm settlement training must be integral parts of the functions of the Training and Manpower Division. Trainees would start in the farm institute where they would receive more theoretical training and then complete in the settlement unit where they would undergo practical training in cooperative farming.

4. The Produce Inspection Division should have as part of its function both plant and animal disease prevention by quarantine operations, and the enforcement of the government seed laws.

5. The State Farms Division is to operate as it does on a commercial basis.

6. The Economics and Statistics Division must be given a research status to undertake research in the economics of agriculture and to provide market information.

7. The Fisheries Division should be also given a research status.

Each division of the Ministry should have a planned program for training its higher grade technical personnel

Development Planning Bodies

The heads of the five new divisions of the Ministry, together with the chief subject matter specialists, the executive director of the Farm Credit Administration and the executive secretary of the Agricultural Research, Education and extension, Council should constitute the national planning body. The executive directors of the National Investment Bank and the Agricultural Development Bank, the executive secretaries of "special crops" development boards, and the managing directors of Ghana Food Marketing Board, and the food distribution "Task Force" may be co-optive members of the national planning body. The representatives of the divisions of the Ministry at the regional headquarters will form the regional planning body. The district planning body should be made up of the district representatives of individual farmers and farmer organizations and private organizations and agencies that provide services to agriculture. The district development plans should be

coordinated at the regional level through the regional planning body by the deputy chief agricultural officer stationed at the regional headquarters.

It is essential that the Ministry of Agriculture should provide training and trained personnel in development planning to the regional and district planning bodies. This calls for organization of in-service training for the regional and district representatives of the Ministry. Trained personnel should also be made available to the regional and district planning bodies to guide in the local level development planning.

The proposed reorganization of the Ministry of Agriculture may be represented by the accompanying organization chart (see Figure 8).

Maximizing the Supply of Administrative Personnel

Once local level participation is called forth in the making and administration of the agricultural development plan it requires motivation of the public sector agencies at the local level to accomplish the implementation of the plan. The major areas of the field staff motivation include on-the-job training, avoidance of frequent staff transfers, regular staff promotions, and improvement of working conditions such as provision of means of transport and staff housing.

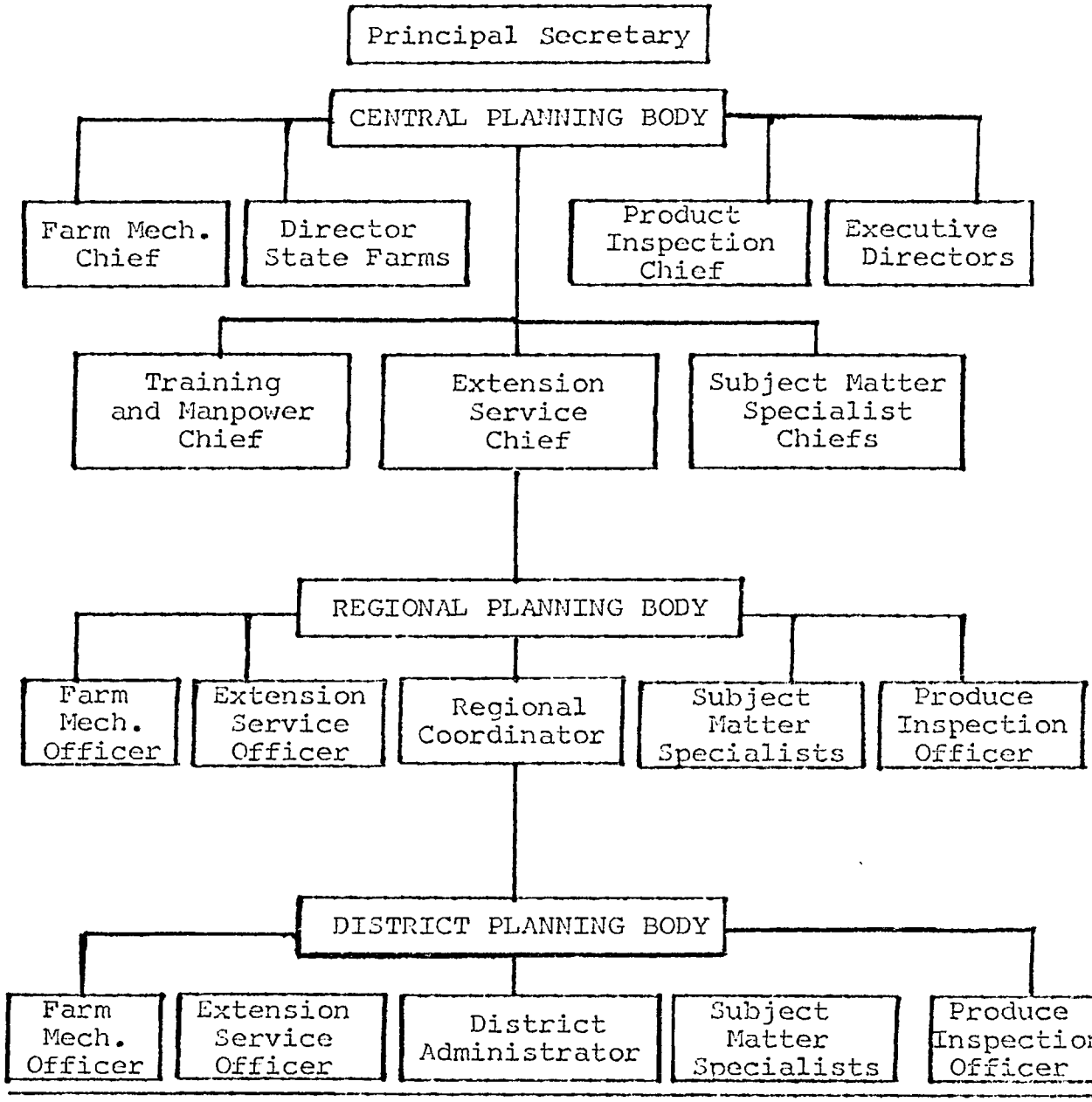

Figure 8. The Organization Chart of the Ministry of Agriculture for Development Planning and Plan Implementation.

Training for Agricultural Field Staff

Trained manpower is the basic bottleneck to agricultural development; to a significant extent, agricultural development programs in Ghana have failed in the implementation phase for lack of personnel with the requisite skills and training. Agricultural development requires large numbers of extension agents and local officials who understand the administrative problems of agricultural development. If these persons are to serve agriculture effectively, they require a wide range of knowledge and skills, much of which are most efficiently provided by a formal educational system.

The first educational requirement for persons serving agriculture at the local level is that they acquire the basic skills and techniques of their job. For many of the jobs in agriculture it requires technical training.

The second need is practical experience taught through the formal educational process. It is common to find the agricultural field staff dominated by persons of urban background with little practical feel for agriculture. It is important to provide a means of acquiring practical knowledge of agriculture within the formal educational structure.

A third requirement is continued education for local field staff. As technology changes, provision must be made

for disseminating that knowledge to those serving agriculture locally. This involves in-service training for the field staff.

Staff Transfers

Transfer of staff is common and frequent in the Ministry of Agriculture. It is not unusual to have an officer transferred from one agricultural region to another and, in some cases, to change stations about two or three times a year. Apart from the time required by the new officer to acclimatize himself and get used to things at the new station, the project he was undertaking at the old station is interrupted and may not be continued to fruition. Many projects in the development plan implementation are thus abandoned through staff transfers. There is often discontinuity of program implementation with the result that it takes a longer period and more capital expenditure through plan adjustments to accomplish the program.

As far as possible, transfer of staff should be minimized to facilitate continuity of service in a locality and to overcome the ill effects of frequent staff transfers.

Staff Promotion

The requisite for motivation of staff to increased effort of achievement is the expectation on the part of the officer that he will be rewarded for his greater achievement.

Staff promotion based on the number of years an officer has satisfactorily served does not stimulate individuals to give of their best. Promotions should be made on the basis also of individual merit and not only on the period of service.

Improvement of Working Conditions

Agricultural field staff are required in their duty to work with the multitude of farmers scattered over the rural farming areas of the country. This contact of field staff with farmers is facilitated by officers living among the rural communities which they serve. They have a greater field coverage in their duty and much contact is effected the greater the mobility of the field staff. It requires, therefore, that decent housing accommodation is provided in most of the rural communities. It also requires provision of some means of transport for the agricultural field staff.

Agricultural field staff, in the past, have been left to themselves to find housing accommodations and have lived in shanty dwellings in the rural communities. They also have had to go about their duty by the public means of transport, which in most parts of the rural areas is scarcely regular and, in other parts, barely existent. The unsuitable living conditions and the relative immobility of the field staff have been the major causes of the gross

indifference of field staff to work in the rural farming areas and their apathy to the needs of their rural clientele. The working conditions of the agricultural staff must be improved if the supply of such personnel is to be maximized in the agricultural development of Ghana.

The need to attract and maintain qualified personnel in the rural areas also calls forth a general development policy to provide rural Ghana with public utilities and amenities such as electricity, good drinking water, post and telegraph facilities and public recreational parks.

SELECTED BIBLIOGRAPHY

Adelman, Irma. Theories of Economic Growth and Development. California: Stanford University Press, 1961.

Agricultural Development Bank, Ghana. Annual Report for the Year Ended 31st December 1970.

Agricultural Development Bank, Ghana. Organization and Function; Accra-Ghana. 1968

Borton, Raymond E. Getting Agriculture Moving. New York: The Agricultural Development Council, Inc., 1966.

Denison, E. F. The Sources of Economic Growth in the United States and the Alternatives Before Us. January 1962.

Europa Publications, Ltd. Africa South of the Sahara, 1971.

FAO. Production Yearbook, 1956-1970. Vols. 10-24.

Ghana Government Development Plans, 1957-70.

Griliches, Zvi. The Sources of Measured Productivity Growth. United States Agriculture, 1940-1960. The Journal of Political Economy, LXXI, 4 (August 1963).

_____. Marginal Productivity in Research and Education. Agricultural Economics Review, LIV, December 1964.

Halloway, R. J. and R. S. Hancock. The Environment of Marketing Behavior. New York: John Wiley & Sons, Inc., 1969.

Hathaway, Dale E. Government and Agriculture. New York: The Macmillan Company, 1963.

Hayami, Y., and V. W. Ruttan. Factor Prices and Technical Change in Agricultural Development, the United States and Japan, 1880-1960. JFE, September/October 1970.

McPherson, W. W. Economic Development of Tropical Agriculture. University of Florida Press, 1968.

Mellor, J. W. The Economic of Agricultural Development. Ithaca, New York: Cornell University Press, 1966.

Ministry of Agriculture, Ghana. Cost of Production Estimates, 1968.

National Investment Bank, Ghana. Act 163, 1963.

National Investment Bank, Ghana. Annual Report for the Year Ended 31st December 1970.

National Investment Bank, Ghana. Objectives; Accra-Ghana.

Nelson, A. G. and W. E. Murray. Agricultural Finance. Ames: Iowa State University Press, 1968.

Robinson, Joan. Economic Philosophy. New York: Doubleday and Company, Inc., 1964.

Schuh, G. E. The Agricultural Development of Brazil. Praeger Publishers, Inc., 1970.

Schultz, T. W. Transforming Traditional Agriculture. Yale University Press, 1964.

Tweeten, A. L. Foundations of Farm Policy. University of Nebraska Press, 1970.

United Nations. Demographic Yearbook, 1968-1969, 20th and 21st issues.

United States Department of Agriculture, ERS, Foreign 265. Indices of Agricultural Production, 1959-1968, 1961-1970, In Africa and the Near East.

Wills, Brian J. Agriculture and Land Use in Ghana. London: Oxford University Press, 1962.

Yhi-Min Ho. Agricultural Development of Taiwan, 1901-1960. Vanderbilt University Press, 1970.