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Food Security, Comparative Advantages, and Fertilizer Use in Ghana

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FOOD SECURITY, COMPARATIVE ADVANTAGES, AND FERTILIZER USE IN GHANA

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1. INTRODUCTION

Background

The agricultural sector in most African countries has a dual role to play in the battle against food insecurity. On the one hand it supplies food directly to domestic markets. On the other it provides employment, income and foreign exchange to large segments of the population to enable the access to domestic and foreign food supplies. In the medium to long term, therefore, the food security problem is one of accelerated growth in agriculture through sustained cost-reducing productivity increases.

The importance of (increased) fertilizer use as a major determinant of long term crop comparative advantage and agricultural growth arises from the need for sustained cost-reducing technological advance and the fertilizer-dependant character of most modern agricultural technologies. The adoption of improved crop varieties and the viability of improved cropping techniques usually require the availability and application of higher quantities of fertilizer.

The way in which the fertilizer sector functions and evolves over time would have a strong impact on long term productivity gains and on production costs in the domestic sectors. Evidence in many parts of the world indicates that in most cases insufficient fertilizer limits potential yield increases, more than varietal factors and agricultural practices do. The efficiency of the domestic fertilizer system (policies and distribution) would have strong implications for the structure and performance of production, and thereby affect the path of crop-wise specialization in the agricultural sector. In fact, a geographic and/or crop-wise bias in the fertilizer use patterns would have a significant impact on the competitiveness of Ghana's agricultural sector vis-a-vis other producing countries.

Objective and Limitation of the Study

The objective of the paper is to analyze the role fertilizer could play in raising productivity in Ghana's agricultural sector and improving food security in the country.

The study is one of four studies on the fertilizer sector of Ghana. The other studies are entitled i). Macro-Economic Policy Environment and Fertilizer Use; ii). Agro-Economic Potential of Fertilizer Use: A Study of Constraints; and iii). Agronomic Potential of Fertilizer Use. These other studies have discussed some issues which otherwise would have been discussed in this report. However, the depth of the analysis of the issues raised in this report has been significantly restricted by the scarcity or availability of the required data collected from secondary sources.

Organization of the Report

The paper is organized as follows. Chapter two discusses the importance of various crops in food consumption in Ghana. It is followed by the analysis of the trends and structure of agricultural production and of the agricultural sector in employment and income generation structure in chapter three. Chapters four and five deal with the structure of fertilizer consumption and the economics of fertilizer use. The potential contribution of regional trade to food security in Ghana and the links to comparative advantage and fertilizer use are investigated in chapter six. The conclusions are presented in chapter seven.

2. TRENDS IN CONSUMPTION AND USE OF AGRICULTURAL PRODUCTS

The links between crop production and (household) food security are best understood by looking at the role of individual crops in food consumption, household expenditures, employment and income generation. It is mainly through these channels that changes in the fertilizer sector through their impact on production performance and the structure of comparative advantages affect household-level security. This section discusses the consumption and use of agricultural products in the Ghanaian context focusing on the evolution of food consumption patterns, the structure of household expenditure, employment and agricultural income.

CONSUMPTION PATTERNS

The most important class of agricultural products consumed by every household in Ghana is the cereals. Maize, sorghum, millet and rice, the main cereals grown locally form the base of most Ghanaian dishes. Maize, however, is the most important and consumed in a variety of forms, including different types of fermented steamed maize dough, porridge, gruel, and roasted green ears. Some consumption takes place on farm, but a large proportion of maize that is grown in Ghana enters the market. Much of this is purchased by food vendors who prepare and sell foods in markets or on the streets of Ghana's cities and towns. Because a high share of maize production is marketed, any variety must be acceptable to processors and consumers. Kenkey is the principal steamed food item from maize, and is the major food consumed among the coastal people in Ghana. In the interior, however, maize is largely consumed in various forms of maize

meals prepared from maize flour. The use of sorghum and millet for cereal meals, however, predominates in the savannah areas.

It is significant to note the relative importance rice has assumed in the diet of most Ghanaians (the elite in particular) over the years. This has contributed to increases in domestic production as well as imports to cater for demand. Of the cereals produced locally, it is only rice which still has a high import content (Table 2.1). Between 1983 and 1989, rice imports constituted an average of about 59 percent of total availability. In the same period, about 56 percent of rice imports was in the form of food aid. The share of aid flow in total rice availability averaged about 33 percent in that period. This is a dramatic change for a country which in the mid 1970s was self-sufficient in rice production and consumption.

Another cereal which is significant in the consumption basket of most Ghanaians (particularly the urban elite) is wheat. This is wholly imported through commercial imports and food aid. An average of about 30 percent of wheat imports was food aid between 1985 - 1989.

Apart from cereals, roots (cassava, cocoyam), tubers (yam) and plantain form a major proportion of the food consumption basket in Ghana. The food consumption patterns, however, vary greatly according to agro-climatic zones and ethnic groups. People in the savanna zone (covering mainly Northern, Upper East and Upper West Regions) consume more of millet, sorghum and yam than any of the other staples. Those in the forest zone (Ashanti, Brong-Ahafo, Eastern and Western regions) eat more of cassava, cocoyam and plantain, and those in the coastal savanna region (Central and Greater Accra regions excluding Volta region) consume more of maize based dishes in the form of <u>kenkey</u>. It is also known that

urban inhabitants consume more wheat products and rice than their rural counterparts. The importance of consumption of food staples by region is illustrated by consumption indices presented in Table 2.2.

In the Northern, Upper East and Upper West Regions which correspond to the savannah areas, millet and sorghum constitute the main staples as indicated by consumption indices of at least 3, rendering the consumption of these commodities insignificant in the rest of the country.

It is significant to note from Table 2.2 that farmers do not necessarily eat all they grow. For example, Ashanti is a major producer of maize, yet the index of consumption is below one. In the same way, the Northern Region produces more than half of all rice produced in Ghana and yet the index of consumption does not differ from the other regions. This implies that there is a high level of interregional trade within Ghana or between Ghana and other countries in agricultural products.

HOUSEHOLD EXPENDITURE

Data on consumption expenditure are extremely difficult to come by without actually carrying out a household survey over a period of time. In discussing this topic, reliance is therefore placed on the preliminary results of the Ghana Living Standards Survey (GLSS) for 1988. A weakness of this data source is that components of consumption expenditure are aggregated. Thus, the tables presented in this section refer to annual household expenditures including expenditure on food, household activities, actual and imputed rent on dwellings, health and education, "use value" of durable goods, remittances paid out and all other daily and annual expenditure.

Table 2.3 gives the distribution of households by locality and by expenditure quintile. It spells out clearly expenditure differentials between rural and urban areas. Whereas about 15 percent of the rural population belong to the highest expenditure group (fifth quintile), an average of 35 percent belong to this group in the urban areas. Further disaggregation of the urban areas indicates that over 46 percent of households in Accra belong to the highest expenditure group. However, between the second and fifth quintiles there does not seem to be much difference in the level of expenditure for both rural and urban areas outside Accra.

It is significant to note that food constitutes about 54 percent of all household expenditure. However, the lowest quintile, who are probably the poorest too, spend over 70 percent of their total expenditure on food. This leaves them with only 30 percent margin to cater for a host of other non-food expenditure items such as rent, health and education of children. As expected, the highest expenditure quintile spends less on food even though 56 percent expenditure on food is also on the high side. Thus, on the whole, food constitutes a major item on the household budget of all Ghanaians.

Total expenditure on food, however, differs from one locality to another. Households in Accra seem to spend more on food than other consumer items in urban and rural areas. On the average, 48 percent of all expenditure in Accra is on food as compared to 41 percent for rural areas. These percentages are lower than the quintile expenditures on food because the values of home-produced food are excluded in the computation.

Expenditure level also varies with the type of employment (Table 2.4). The table indicates that employees in the third and fourth quintile seem to be evenly

distributed irrespective of the type of employment. In the highest quintile, however, more households (about 38 percent) in private firms are within the highest level of expenditure followed by government employees with 32 per cent. Self employed have the lowest level of expenditure than the rest in the lowest quintile. Within each employment category, however, expenditure levels seem to be more evenly distributed among the self-employed households than the others, while there is a wide gap between the lowest and the highest quintiles for government employees and employees of private firms. It is important to note at this juncture that activities in the informal, self-employed sector are closely linked to the agricultural sector. The high share of this group in the lowest quintiles indicates the importance of performance in the agricultural sector for food security in the urban areas.

Moreover, the discussion in this section shows that food constitutes the highest proportion of household budget across all expenditure quintiles. Cost-reducing technologies in the agricultural sector are therefore crucial for the purposes of food security.

EMPLOYMENT

It is crucial for the economically active population to be employed if they are to have access to food. While detailed employment statistics are hard to come by, inter-censal data on labor force participation provide useful information on the structure of the labor force. Table 2.5 gives an idea of labor force in agriculture from national censuses. The decline in agricultural labor force can be attributed largely to the reduction in the relative number of peasant farmers and an increase in the relative share of service and industrial

sectors (Ewusi et. al., 1988). Nevertheless, agriculture continues to be the avenue of employment for the highest proportion of the economically active age group in the population (15 - 64 yrs). The increased proportion of the economically active population engaged in agriculture around 1987 underlines the lack of expansion in industry and service sectors which drives labor to seek refuge in agriculture, or a stronger expansion of the agricultural sector itself. The high employment share reveals the intrinsic importance of improved production technology in agriculture.

3. STRUCTURE AND PERFORMANCE OF AGRICULTURAL PRODUCTION

The analysis of the structure and performance of agricultural production in the country is the logical point of the analysis of comparative advantages. The output is a description of the current state of comparative advantages in the country.

PRODUCTION STRUCTURE

Agricultural production in Ghana is aimed at achieving multiple objectives such as: i). food to feed the human population; ii) feed for livestock; iii). earning and saving foreign exchange and iv). raw materials to feed local industries. A multitude of crops are therefore cultivated in order to meet these and other objectives. The environmental conditions and soil types in the country are such that some crops have natural advantage or are more successfully cultivated in some agro-ecological zones than others. The main agro-ecological zones as shown in Map 1 are: i). the high rain forest; ii). the semi-deciduous rain forest, iii). the forest-savanna transition, iv). the northern savanna and v). the coastal savanna. The climatic conditions and soil types in the agro-ecological zones which are more relevant for plant growth are presented in the Appendix.

Crops Grown

The major crops grown in the agro-ecological zones are shown in Table 3.1. The crops belong to the categories of i). cereals, ii). roots, tubers and plantains, iii). vegetables, iv). tree crops and v). industrial crops.

i) Cereals: Cereals are among the major foodcrops produced and also consumed in the country. Four types of cereal crops are produced, namely, maize, rice, millet and sorghum (guinea corn). The most important among them is maize which accounts for about 55 percent of the total cereal production. It is followed by sorghum which accounts for about 20 percent, millet, 16 percent and rice, 9 percent (Table 3.2).

a) Maize. Maize is grown in all the agro-ecological zones, however, it grows best under natural conditions in the transitional and forest zones where relatively commercial production enterprises have developed . The importance of the crop in the zones as expressed in area cultivated and output is shown in table 3.3. The crop is cultivated under rainfed and upland conditions and largely on small fields averaging about 3 ha. There are a few very large fields such as those cultivated by the Ejura Farms Ltd. in the transitional zone. This particular farm enterprise cultivates about 300 ha.

In the northern savanna zone only one crop of maize is grown in a year due to the unimodal pattern of rainfall there. In the other agro-ecological zones with bimodal rainfall pattern, two crops are cultivated in a year. The first and main crop is cultivated during the major rainy season (April to July) and the second and minor crop is grown in the minor rainy season (September to November). The second maize crop is usually very risky to cultivate due to the unreliable amount and duration of rainfall in the minor season. The second maize crop accounts for less than 15% of the total production in a year. So far no effort has been made to supplement the moisture requirement of the second season crop by irrigation. Where production is commercialized, maize is cultivated in a pure stand; otherwise, it is grown mixed with other crops. In the northern savannah

zone, it is mixed mainly with millet, sorghum, and cassava, and in the transitional and forest zones it is usually mixed with cassava, cocoyam and plantain.

b) Sorghum and Millet. Sorghum and millet are also upland cereal crops grown mainly in the northern savanna zone and marginally in the transitional zone (Table 3.3). The crops are grown mainly for subsistence on very small fields averaging less than 1 ha. Only one crop each of sorghum and millet is grown in a year due to the unimodal rainfall pattern in the northern savanna zone. The two crops are grown mixed with each other and with maize and cassava.

c) Rice. The contribution of rice to cereal production in the country is the lowest, forming less than 10 percent. The quantity produced falls below demand of which over 50 percent is met through imports. The crop is grown in all the agro-ecological zones, but predominantly in the northern savanna zone which accounts for about two-thirds of the total production (Table 3.3). In the northern savanna zone rice is grown mainly in the upland under rainfed conditions. A relatively small proportion is grown under irrigated conditions. In the transitional zone, the crop is mainly grown in the upland under rainfed conditions, while in the forest zone it is grown in the lowland areas (valley bottoms) under rainfed conditions. In the coastal savanna zone, it is grown mainly in lowland areas under irrigated conditions (Table 3.4)

Rice is grown in the northern and coastal savanna zones mainly as a cash crop and for subsistence in the other zones. The rice fields are quite large in the northern savanna zone averaging about 20 ha. In the other agro-ecological zones, the fields are quite small averaging about 1 to 2 hectares.

Rice cultivation in the northern savanna zone is mechanized from land

preparation to harvest, and in the other agro-ecological zones mechanization is usually partial (only in land preparation) or completely absent in the systems of cultivation. Under rainfed conditions, only one crop of rice is grown in a year. The opportunity offered by irrigation to grow a second crop is usually utilized in the coastal savanna zone but not in the northern savanna zone where the farmers prefer, for monetary considerations, to grow vegetables, particularly, tomato in the dry season.

Rice production received a big boost during the first half of the 1970s in the northern savanna zone, transforming the zone into the major commercial rice production area in the country. Now there is a programme to increase rice production in the forest area, particularly in the numerous uncultivated valley bottoms.

Roots/Tubers/Plantains

Roots, tubers and plantains are important starchy crops produced and consumed in the country. The major crops in these categories are cassava, cocoyam, yam and plantain. In terms of quantity produced, cassava is the most important accounting for about 46 percent of the total starchy crops followed by plantain which accounts for about 20 percent, cocoyam 19 percent and yam 15 percent (Table 3.5).

Cassava. Cassava which used to be grown mainly in the forest and transitional zones has now spread to the northern and coastal savanna zones (Table 3.6). This is because it thrives quite well on the relatively poor soils and drier conditions in the savanna zones. Cassava is an upland crop grown under rainfed conditions. The cassava fields are generally small averaging about 2 ha. and

usually cultivated mixed with other crops, notably, cocoyam, plantain and maize in the forest and transitional zones; and with maize, millet and sorghum in the northern savanna zone. In the forest and transitional zones the crop is being increasingly cultivated as a cash crop while in the savanna zones it is grown mainly as a subsistence crop.

Plantain. Plantain is grown mainly in the forest and transitional zones as an upland crop (Table 3.6). In the semi-deciduous forest zone where cocoa is mainly grown, plantain is planted mixed with cocoa in order to provide shade needed by young cocoa trees. In other fields, plantain is usually planted mixed with cocoyam, cassava and maize. Plantain used to be grown mainly to meet subsistence needs but it is gradually becoming a cash crop particularly in the forest zones. The plantain fields are generally small averaging about 2 hectares.

Cocoyam. Like plantain, cocoyam is an upland starchy crop grown in the forest and transitional zones (Table 3.6). It is usually grown mixed with plantain, cassava and maize. It is grown as a subsistence crop in small fields averaging about 2 ha.

Yam. Yam is grown in all the agro-ecological zones except in the coastal savanna zone. Different species are grown in the different agro-ecological zones due to their different climatic, soils and other environmental requirements for growth. However, it is the species grown in the northern savanna and the transitional zones which form the bulk of production for market (Table 3.6). Yam is an upland crop grown under rainfed conditions. The yam fields are generally small averaging about 3 ha. The production system has remained traditional with no form of mechanization. In the northern savanna and transitional zones, the

crop is grown for market, and in the other zones, production is geared toward subsistence needs. Yam is gradually becoming an important non-traditional export commodity going mainly to European markets. The quantity exported has increased considerably in recent years from about 700 mt in 1988 to over 2000 mt in 1990.

PERFORMANCE OF PRODUCTION

The production performance of foodcrops is analyzed from the standpoint of trends in : i), output, ii). imports and exports, and iii). consumer prices

Trends in Output

Food production indices estimated by FAO show that there was a consistent decline in food production from the early 1970s to 1983. In that period the food production index declined by over 30 percentage points. For the rest of the 1980s, food production took an upward trend adding over 60 percentage points to the 1983 index. In 1990, there was a big drop of about 14 percentage points in the index compared to 1989 (fig.3.1).

Trends in per capita food production is used to assess whether the country is satisfying her objective of producing adequate quantity of food to feed the population. The trend in per capita food production (fig. 3.1) shows that Ghanaians probably had access to more food in the early 1970s than in the late 1970s and the early 1980s. The index of per capita food production reached the lowest level in 1983, showing a drop of about 67 percentage points compared to 1974. The upward trend since 1984 has not been spectacular. Trends in indices of both total and per capita cereal production (fig. 3.2) followed, generally, the same patterns as that of total food production, except that cereal production was particularly low in 1983 when the index was less than 40 percentage points.

Production growth rates of the major cereal and starchy crops are indicated in Table 3.7. Among the cereals only rice showed a reasonable positive growth rate of over 3 percent per annum over the last two decades, 1970 to 1990. However, the annual growth rate was highest in the 1970-75 period (8.98%) and declined in a fluctuating fashion to about 0.25 percent in the 1985-90 period. The annual growth rate for maize was less than 1 percent over the 20 year period 1970 to 1990. However, unlike rice, the annual growth rate showed an upward trend after the 1970-75 period when the growth rate was negative, reaching 8 percent in the 1985 - 90 period. Both sorghum and millet showed negative annual growth rates over the period 1970 to 1990. However, for Sorghum, the growth rates were positive over the period 1975 - 85. For millet it was only positive in the 1975 - 80 period. Thus, with the exception of maize, the outputs of the other cereals (rice, sorghum and millet) has not been significantly higher than they were in the early 1970s.

Among the major starchy staples, only cassava had a positive annual growth rate of less than 1 percent over the 20-year period, 1970-90 (Table 3.7). However, the growth rate has been declining since 1975. The annual growth rates of plantain, cocoyam and yam were all negative over the 20 year period. However, in the 1980-85 period, they all registered positive growth rates but only yam continued the upward trend up to the end of the decade. Like cereal crops (except maize) the output performance of the major starchy staple crops were lower in the 1980s than they were in the first half of the 1970s, except in the case of cassava.

The poor performance of food production in the country can be attributed to a number of factors such as : i). unreliable rainfall which sometimes resulted

in drought, ii). continued use of traditional technologies, iii). poor incentives including farm gate prices and outlets for marketable surplus, iv). subsistence focus in production, v). not using fertilizer to improve soil nutrients after considerable depletion, etc.

Food Imports

The country does not have the climatic and other environmental conditions to grow all the crops consumed. A typical example is wheat the cultivation of which is favourable mainly in temperate climatic zones. It is not grown in the country at all. The importation of some foodcrops therefore becomes necessary. Also going by the principles of comparative advantage, a country may import some foodcrops although she could produce them and concentrate in the production of others in order to maximize total availability of all foods needed for consumption. Aside from these and other considerations, a country may import some food items if the local production is not adequate to meet demand. Ghana imports some food items precisely for that reason, that is, to supplement inadequate local production. Among the major food crops that have featured in food imports are rice and maize. The importation of rice dates back to the 1950s and it is now the major foodcrop that features in the annual food imports. The quantities imported annually since 1970 are shown in Table 3.8.

In the early 1960s, the country was less than 30 percent self-sufficient in rice production. After that period, the self-sufficiency rate took an upward trend to reach about 48 percent in the first half of the 1970s. It then declined to about 41% during the first half of the 1980s, but in the second half of the 1980s the domestic production satisfied nearly 54% of the demand (Table 3.9).

In spite of the relatively large imports of rice to supplement local production, per capita consumption of rice is still the lowest among the cereals grown in the country (Table 3.10). It appears therefore that there is room for the country to consume higher levels of rice. This can be expected with increase in incomes and rapid urbanization which are among the factors accounting for increased rice consumption in the West African subregion (Nyanteng, 1987).

Maize Imports. Smaller quantities of maize have been imported in some years than rice (Table 3.11). Also the maize imported since the early 1970s were of the yellow maize variety which is used mainly as livestock feed, particularly poultry. The relatively large quantities of maize imported in 1981 to 1984 were, however, used for human consumption due to inadequate local production. It should be noted that the country has not imported any maize since 1985 except 10,000 mt. in 1987. This implies that the country attained self-sufficiency during that period. With the increasing trend in maize production, the country may become a net exporter in the near future. Already some maize has been exported to some African countries in 1984 and a few other years. There is also the possibility that the country may begin to use maize flour in bread making instead of the overwhelming use of wheat flour which is all imported. Thus, there is a need to find other uses for the locally produced maize or export in order to maintain the rapid pace of production.

Food Prices

The level of food prices is an indicator of the extent to which food supply meets demand. The consumer price index for food in the last two decades (1970 to 1990) shows that food prices went up quite steeply, particularly since 1977 (Table 3.12). In several instances, the index doubled or tripled in a year or

two. In the 1960s and 1970s, the food price index increased faster than the prices of the other components of the consumer basket, implying that food prices contributed bigger proportions to the rate of inflation in the country (Stoces, 1966; Ewusi, 1977; Nyanteng, 1978). Before 1977, food was given a total weight of 55.1 percent (local food 52.1 percent and imported food 3.0 percent) in estimating the combined consumer price index. From 1970 to 1977 before the weights were changed food prices contributed about 52 to 86 percent annually to the rate of inflation (Table 3.13). Since 1977, local and imported foods have been assigned a total weight of 49.20 percent in estimating the combined consumer price index. With this lower weight, food prices contributed about 40 to 75 percent annually to the rate of inflation from 1978 to 1990 (Tables 3.13 and 3.14). From 1986 to 1990 the contribution was about 30 to 38 percent. However, the levels of contribution still made food prices the highest contributor to the rate of inflation in the country in the last three decades.

AGGREGATE TRENDS

The trends depicted for the various zones in the previous sections are also observable at the aggregate level. The recent successes in production particularly of maize are reflected in the reversal of the crop production index at the end of the seventies and its rapid increase during the eighties (fig. 3.3). In order to strengthen the country's comparative advantages and improve long term food security, it is imperative that the production trends of the eighties be sustained. In fact the strong increases of the eighties have not raised production levels much above that of the early seventies. But they have significantly contributed to reversing the strong losses of the seventies. That

the observed production gains, without rapid changes in the use of improved technologies, particularly of fertilizer, may weaken very soon, will become clear in the next chapter.

The need for stronger productivity gains in crop production is supported by the rapid decline in aggregate agricultural exports after the steady increases of the seventies. The decline in overall real exports is primarily due to the fall in traditional Ghanaian agricultural exports. However, the country has a significant potential of alternative export crops (Obimpeh 1989). The potential of maize to become a viable export crop has been pointed out in the discussion above.

After a steady rise from the mid-sixties to the early seventies, agricultural imports have decreased rapidly since then. It could be argued that the recent success in crop production has led to the fall in imports. As observable from figure 3.3, however, the contraction of imports started much earlier than the increase in the crop production index. Moreover, the import index displays a much closer relationship to the index of aggregate agricultural export earnings. It is therefore very likely that the combination of falling exports and imports has hurt the objective of food security in the country, given the role of agriculture and food in the employment and expenditures of poor households, and the stabilizing impact of imports on food prices (see Tables 2.3; 2.5; and 3.13)

Sustained increases in the productivity levels in agriculture are necessary to facilitate the higher levels of exports and imports that, along with higher domestic production, often go with improving the availability of and access to food. This represents the main avenue through which fertilizer use is expected

to affect long term food security. The extent to which fertilizer will contribute to raising productivity levels is investigated in the next section.

4. AGRICULTURAL PRODUCTIVITY AND FERTILIZER USE

AGRICULTURAL PRODUCTIVITY

The evolution of comparative advantages is governed by long term changes in crop yields. The analysis of the yield dynamics for different crops and across agro-ecological zones is one way of investigating the state and progress of technology in Ghanaian agriculture. The application of fertilizer is itself a component of cropping technology. The various technological packages (varieties and practices) available to farmers are associated with differing levels and types of fertilizer requirements. Accordingly, the analysis of the gap between actual and required levels of fertilizer application would be very helpful in understanding the actual structure and potential changes in crop comparative advantages. Along with resource endowment, the accumulation of technological know how is a major determinant of comparative advantages. The relative performance of single agricultural sub-sectors will, therefore, be very sensitive to the prevailing patterns of distribution across crops of fertilizer use and related practices. The analysis of these interrelationships is of great importance from the point of view of resource allocation, overall agricultural development and long term food security.

Technology is normally developed to aid labor productivity by facilitating the substitution of relatively abundant (hence cheap) factors for relatively scarce (hence expensive) factors in the economy. The use of fertilizer in crop production is generally to release constraints on growth imposed by inelastic supply of land thereby facilitating the substitution of labor for land through

intensive cultivation of land. Increases in yield per unit of land also increase the productivity of labor. This chapter therefore examines changes in yield of major food crops in Ghana, and the role of fertilizer and other determinants in these changes.

Yield Trends

Of the total land area of over 23.8 million hectares in Ghana, the arable area is 13.6 million hectares of which 6.9 million hectares are actually under cultivation. Thus, about 30 percent of the total land area is now under cultivation compared to about 12 percent estimated by the FAO (1977) in the mid 1970s. While some food crops are grown in the forest areas of Ghana, about 80 percent of all annual crops are grown in the non-forest areas which form about 60 percent of total land area of Ghana. These are the areas most suitable for annual crops as opposed to perennial crops in the forest areas. Thus the yield trends indicated in Table 4.1 apply more to the non-forest areas than to the forest areas.

The table shows clearly that yields have not increased significantly over the past two decades. In fact for almost all crops, yields have tended to be stagnant and not varying significantly from the mean over the 21 year period. More importantly, the average yields per hectare for all crops are far below their potential (Table 4.2). The potential yields in the third column represent the best yields at the Agricultural Research Stations under the crop improvement programmes.

The progressive yields are those observed among farmers that apply relatively more advanced technologies. Maize is the most widespread staple food crop in Ghana which is grown in all the political regions. Yet the average yield

of maize for the past two decades is only about 20 - 50 percent of its potential yield. The crop, apart from cocoa, has also received the most attention in terms of research and extension.

The cultivation of rice on commercial basis gained importance in this country only from the mid 1960s. The crop since then has received a lot of focus by way of research, experiments, extension and production inputs. In addition, it has benefited from international transfer of technology, with new varieties and methods of cultivation being imported mainly from the South-East Asian countries. Despite all these, average yields are still very low and are only about 30 - 50 percent of potential yields.

Millet and Sorghum are the major staples in the interior savannah areas. They are grown mainly for subsistence. Until recently when efforts have been made to develop improved varieties of these crops at the Nyankpala Agricultural Experimental Station (NAES), very little attention had been paid to these crops in terms of research and extension. Though a lot has been accomplished so far at Nyankpala, the potential yields of these crops are still far below that of maize and rice. In addition, farmers' yields continue to be virtually stagnant and in terms of their potential yields are only about 20 -50 percent.

Data on potential yields for the tubers show a similar pattern to that of cereals. Yields of yam and cassava are 51 and 28 percent of the potential yields obtained at research stations of respectively 7 and 3 tons per hectare. Cotton yields over the years followed the same pattern as the cereals, with the average yield for the past two decades being only 24 percent of its potential yield.

National averages, however, tend to mask the situation at the regional level. Not all crops are grown at the same intensity in all regions. Besides,

soil and microclimatic conditions differ from region to region and are likely to have their impact on the performance of crops. Thus, Table 4.3 shows a five year average (1987-1991) for yields of crops for the various administrative or political regions in Ghana (Map 2).

Maize tends to vary significantly in yield from one region to another. The highest average yield of 1.68 mt per hectare is recorded in the Eastern Region. This represents 34 percent of the potential yield. On the whole, all the regions in the forest zone (Western, Central, Eastern, Ashanti, Brong Ahafo and Volta) record yields above 1 mt per hectare. Over 90 percent of the maize grown in Brong Ahafo is produced in the transitional zone. Thus, the average yield of 1.62 mt per hectare represents the yield in the transitional zone. This is also about 32 percent of potential yield.

It is significant to note that yields are particularly low in the Northern Savannah areas (North, Upper West and Upper East Regions) where they are below 1 mt per hectare and are about 18 percent of potential yield for Northern and Upper West Regions and only about 11 percent for Upper East Region. Soils in this region are generally poorer and crops often suffer from water stress due to insufficient rainfall.

The average yield in Greater Accra which represents the coastal savannah is also above 1 mt. It is thus clear that so far as maize is concerned it is low average yields from the Northern Savannah areas that tend to pull down national averages.

Rice is also grown in all the political regions with the average yield being highest in the Northern Region. However, apart from Greater Accra in the Coastal Savannah where average yield is far below 1 mt per hectare, average yield

in all other areas is close to or slightly above 1 mt. In fact, there do not seem to be significant differences in yields of rice with respect to political and ecological regions.

Sorghum and millet are grown principally in the Northern Savannah areas. In both crops, average yields are far lower in the Upper East Region than in the other two regions. The Upper East Region is the driest and the most resource unendowed region in the country. Soils are poor and rains often fail, resulting in either poor harvest or complete crop failure. It constitutes a block of the most food insecure area of Ghana.

For the root crops (yam and cassava) average yields do not vary greatly from region to region. They are however highest in the Eastern Region for yam and in Brong Ahafo for Cassava.

Since the level of production of these crops is not the same in all regions, the contribution of the region to production is important in influencing the evolution of average yields. Table 4.4 gives a five year average contribution to production by region, of the major annual crop.

It is clear from the table that the Northern Savannah areas, where average yields are low, contribute a total of about 22 percent to annual production of maize. The "pull-down" effect on the average yield of maize by this zone is therefore significant. The forest areas (Western, Central, Eastern, Volta, and Ashanti) where average yields are above 1 mt per hectare contribute an acreage of about 57 percent to total production. The transitional and coastal savannas contribute about 19 and 2 percent respectively. It is significant to note that the major regional producer of maize, Brong Ahafo in the transitional zone, also has a high average yield of 1.62 mt per hectare even though this represents only

43 per cent of potential maize yield.

Although all regions produce rice, over 55 percent of it is produced in the Northern savannah regions where average yields, although low, do not vary much. Outside the Northern savannah, the only other region which produces a significant amount of rice is the Brong Ahafo Region which produces over 16 percent of domestic rice. Thus the Northern Savannah and the adjacent transitional zone together produce about 72 percent of domestic paddy rice.

For the tubers, the transitional and the Northern Savannah areas again produce about 75 percent of yams in Ghana. Thus, for the production of food crops, the savannah and transitional zones together constitute Ghana's 'bread basket'. However, yields are far below their potential, and research and extension work ought to be intensified in these areas.

Low and stagnant yields point to the fact that production technology has not changed much over the years.

FERTILIZER USE

Perhaps the most important modern input in Ghana's agriculture is fertilizer. All the fertilizer is imported and used almost exclusively on annual cereal crops. This constitutes the principal reason for different levels of fertilizer use within different ecological zones, since fertilizer use depends on the type of crops grown in these zones rather than the inherent fertility status of the soils (Obeng et. al. 1990). For instance, the major crops cultivated in the forest zone are rubber, coconut, oil palm, cocoa, citrus, plantain and cassava. These crops are, as a general rule not fertilized by Ghanaian farmers. However, some supplementary fertilizer application is done on

plantations by farmers applying modern techniques.

Fertilizer is largely used in the northern and coastal savannah zones where the cultivation of annual root crops and cereals predominate and where soils are inherently low in soil fertility. Even then, Obeng et al (Ibid.) have established that about 82 percent of a sample of 1127 farmers interviewed did not apply any type of fertilizer to their farms. This implies that only one farmer in five used fertilizers in the 1989 farming season. The authors also established that about 87 per cent of large scale farmers used fertilizer as against only 18.4 percent of small scale farmers in the same season. This is not a healthy situation if one considers that over 90 percent of agricultural production in Ghana is from the small-scale farmers.

The use of fertilizer in growing maize has increased rapidly in the country relative to all other foodcrops. This is largely due to some special projects such as, the Sasakawa Global 2000 Project which was implemented initially to boost maize production in the country. Under this project, farmers are supplied with fertilizers and improved seed on credit. The project started in 1986 in the northern savanna zone with 40 farmers. By 1989 the number had increased to over 47,000. Since 1988, the Sasakawa Global 2000 project has been introduced in some of the other agro-ecological zones. Other public agencies such as Farm Services Company (FASCOM), Volta Region Agricultural Development Project (VORADEP), Upper Region Agricultural Development Project (URADEP), etc. were also set up to distribute farm inputs notably fertilizer and to provide services to farmers in a "Special Area Development Programme" which covered most parts of the northern savanna zone. Maize production has good prospects in the northern savanna zone where the topography is most suitable for large scale mechanized farming, and

around the two large irrigation facilities at Tono and Vea, two crops can be cultivated in a year.

In the case of the two traditional cereals, sorghum and millet, the use of fertilizer is not wide spread due largely to the fact that they are mainly cultivated to meet subsistence needs. However, under the Sasakawa Global 2000 Project and other developmental programmes, farmers are being encouraged to use fertilizer to grow these cereal crops. The use of fertilizer is quite wide spread in rice cultivation in all the agro-ecological zones, but predominantly in the northern and coastal savanna zones. Cassava, on the other hand, responds quite well to fertilizer application, but it is generally not used in growing the crop even where cultivation is commercialized. Similarly, fertilizer is not used in the cultivation of the other two remaining crops, plantain and cocoyam.

Research results also show that yam production can benefit from the use of fertilizer. However, it has not been used in the production of the crop. This is partly due to the fact that yam is usually grown on land that has lied fallow for a minimum of about 5 years and it is therefore referred to as new land. The crop is cultivated only once on the land and production is shifted to a new land.

Table 4.2 summarizes the importation and use of fertilizer on cereal crops. Assuming that all fertilizer imports are used on cereals and that a conservative estimate of 150 kgs are used per hectare, the table indicates that fertilizer use in cereal production is very low ranging from 18 to 49 per cent for years in which fertilizer was imported. In years when no fertilizer was imported, one assumes that no fertilizer was used since Ghana does not have a local fertilizer industry and any fertilizer used would have been from stocks carried over. It is significant to note the low level of fertilizer use for 1984 to 1990 when

fertilizer use averaged about 21 percent per year compared to 44 percent per annum for the period 1978 to 1980.

Low levels of fertilizer use in the latter period which corresponds to the era of structural adjustment could be attributed to general liberalization in the economy resulting in the removal of subsidies on fertilizer and other agricultural imports.

Subsidies on inputs had been used as a useful tool to encourage farmers to use new inputs such as fertilizer, improved seeds and mechanization. The use of the latter too serves to reinforce the use of fertilizer. However, Jebuni and Seini (1992) explain the rationale for removing subsidies on the realization that "subsidies tend to encourage the inefficient use of inputs and also to distort resource combination at the farm level, and also, in Ghana's case subsidies often benefited only or mainly the large and rich farmer while the small poor farmer remained deprived". Thus even though removal of subsidies on fertilizer may have affected its use, it may have affected the large scale rich farmers more than the small-scale, generally poor farmers.

It is significant to note that in the survey results of Obeng et al. (1990) as much as 93 percent, 89 percent and 87 percent of farmers not applying fertilizers in the forest, savannah and transitional zones, respectively, have indeed never used fertilizer. Thus, in spite of several decades of fertilizer imports into Ghana, its use is rather very thin. The low average yields in annual crops production, discussed earlier on, could therefore be attributed to a generally low level of technology in production.

It is worth noting that though about 40 percent of the total land area is now under cultivation as opposed to 12 percent in the 1970s, the trend in food

production in the 1980s has not been significantly different from that of the 1970s. If one considers maize, for example, the best total production of 598 thousand metric tons in 1987 is only 23 percent above maize production in 1974. Between these two years, land under cultivation increased by 29 percent for maize. This implies that increases in maize production have not moved in sympathy with increases in land under cultivation resulting in low land productivity over the years.

TECHNOLOGICAL PACKAGES TO FARMERS

Over the years, a number of technological packages have been introduced through extension services. These have been mainly improved seeds, fertilizer and planting in line and at the right spaces. Nevertheless, these packages do not seem to have made any widespread impact since average yields of annual crops continue to be low, stagnant and far below their potential. In fact, the previous discussion shows a combination of modest yield-levels with low rates or the absence of fertilizer application for many crops in most areas of Ghana. This clearly suggests that fertilizer use can play a significant role in sustaining long term food security by raising performance in the agricultural sector to increase domestic food supplies and expand the country's export production capacity.

Figure 4.1 shows the evolution of fertilizer use and crop output. There seems to be some degree of correlation between the trend of fertilizer application and the level of crop production, especially during the period of relative output expansion of the 1980s. However, the apparent stagnation of yields across most crops that is observable in Table 4.1 would indicate that

fertilizer has at best contributed to sustaining yields at their present level. Given the insignificant levels of fertilizer application and the poor quality of data that are available on output and input use, it has not been possible to test this relationship empirically.

An alternative, and probably more suitable, way of looking at the possible contribution of fertilizer use to improving food security is to consider its relationships to potential rather that historical yield levels. This can be done with the help of the data presented in Table 4.2. The first column of the table shows the level of yields among farmers applying traditional production practices. Yields among this group of farmers are much lower than that achieved by progressive farmers, that apply more advanced production techniques such as increased use of fertilizer. However, the yield levels that are presently achieved by both groups of farmers are significantly below potential yield levels in Ghana.

The last column of the table shows fertilizer response coefficients for areas such as those where most crops in Ghana are grown. It was pointed out in the discussion in the section on fertilizer use that even in the higher-fertilizer-use areas of Ghana, more than 80 percent of the farmers do not apply any fertilizer at all. Aggregate yield levels may therefore be closer to the "traditional" levels shown in the first column of the table. In this case, the higher fertilizer response coefficients seem to be more accurate. In any case, the prevailing productivity gaps and the high fertilizer response coefficients indicate that higher fertilizer application would have strong positive effects on agricultural performance and long term food security.

In fact, the previous discussion shows a combination of modest yield-levels

with low rates or the absence of fertilizer application for many crops in most areas of Ghana. This clearly suggests that fertilizer use can play a significant role in sustaining long term food security by raising performance in the agricultural sector to increase domestic food supplies and expand the country's export production capacity.

5. ECONOMICS OF FERTILIZER USE

The data cited in the previous section indicated that fertilizer consumption is very unevenly distributed, both across agroecological areas and across individual crops. Apart from maize and rice most crops do not receive any significant amount of fertilizer. The level and the distribution of fertilizer consumption is closely linked to the expected profit from additionally produced quantities. Accordingly, it is determined by factors such as the cost of fertilizer relative to the price of output, the availability of complementary inputs, prevailing technical practices, and the risk and uncertainty on product markets. Due to limited data availability, the analysis in this section will focus on the role of the relative cost of fertilizer and on output market conditions.

The evolution of real crop prices partly reveals the changes over time in the incentives to expand crop production, and therefore the propensity to invest in improve cultivation techniques. The trends in maize, millet and cassava prices deflated by the consumer price index are presented in Figure 5.1. Apart from the few peaks in trends in the mid-seventies and the early eighties, real crop prices display a declining, at least stagnating, trend. While maize prices were picking up in the second half of the eighties, millet prices have remained at their lowest levels throughout the eighties.

The evolution of the real cost of fertilizer is a more accurate indicator of the changes in the incentives to raise fertilizer consumption. Figure 5.2 has been prepared for this purpose. It shows the ratio between the average price of

fertilizer, on the one hand, and the prices of maize, millet and cassava. For all three crops, the fertilizer price ratio has fallen steadily until the early eighties. Fertilizer consumption, even though mainly confined to maize, showed some hesitant upward trends during the same period.

Since 1987 the relative cost of fertilizer has increased quite rapidly. The use of fertilizer has thus become much more costly over the last few years. Fertilizer prices were heavily subsidized until 1990 when they were de-subsidized (see table 5.1). The de-subsidization policy was initiated in 1985 to phase out subsidies over a period of five years ending in 1990. The policy formed part of agricultural sector policies under the structural adjustment programme (SAP) which preceded an economic recovery programme initiated in April, 1983. The change in the levels of fertilizer cost can be explained by the de-subsidization policy. The policy therefore is likely to reduce the demand for fertilizer use, particularly, among the small scale farmers who dominate the Ghanaian agricultural scene.

The price ratios in Figure 5.2 may underestimate the real cost of fertilizer because they are based on official producer prices. However, it has been shown that prices paid by farmers could be as much as four times higher than officially announced prices (Stryker et al. 1990, p. 115). The usefulness of the official relative fertilizer price ratio as a determinant of fertilizer use is similarly limited in cases where constraints in the distribution system restrict fertilizer availability. As part of restructuring the input supply and distribution systems in the country, fertilizer supply and distribution have been privatized since 1988. The expected outcome of the privatization policy is to increase availability at the farm gate. However, at the moment, there seems to

be reduced accessibility to fertilizer use due to sluggishness of private sector participation.

An equally important aspect of the incentives to adopt improved production techniques such as the application of fertilizer is the stability of real crop prices. The levels of and relationships between fluctuations of crop and fertilizer prices have a strong effect on long term rate of fertilizer application. High levels of instability in relative prices reduce the expected profit from additional output quantities and discourage investments in output expansion. Table 5.2 shows crop and fertilizer prices in constant cedis from 1970 to 1990. The bottom rows of the table show the degree of instability of the different prices and correlation between crop and fertilizer price changes. The indicator of price instability is the coefficient of variation.

The coefficient of variation of 20 to 30 percent display high levels of variation across all four crops. More important from the point of view of the present discussion is the much higher instability of real fertilizer prices, with a coefficient of variation of 60 percent. Because the real effect of price instability at the farm level depends on the extent to which individual price fluctuations offset each other, the coefficient of correlation between individual crop prices and the price of fertilizer has been computed. The coefficients of correlation, albeit negative in three out of four cases, are quite low, with absolute values all less than 50 percent. Accordingly, fluctuations in fertilizer prices in most of the years have not been compensated by fluctuations in crop prices.

To sum up, the evolution of real crop prices and of the relative cost of fertilizer as well as their level of stability have not been favorable to high

levels of fertilizer consumption. Moreover, given that Ghana is not a fertilizer producer, the availability of foreign exchange and the efficiency of the distribution system are at least as important as the price environment discussed in this section. Ideally, the analysis of the economics of fertilizer use would have included an applied analysis of these relationships. Some econometric estimations have been attempted. But due to the quality of the data that are available, satisfactory results could not be obtained.

6. COMPARATIVE ADVANTAGE, REGIONAL TRADE, AND FOOD SECURITY IN GHANA

In addition, to its potential impact on resource allocation, inter-country trade can help improve food security through stabilizing local agricultural and food markets. Ghana is not only an importer on regional markets. It also has the potential of becoming a major source of cereals exports to regional markets. The realization of this potential will depend on the country's ability to sustain the competitiveness of its domestic production. Soil fertilization being a major component of cost-reducing technologies, the constraints and obstacles in the country's fertilizer sector can have a significant effect on its capacity to compete on regional markets. The analysis in the present section focuses on the extent to which regional trade can contribute to the objective of food security in Ghana. It also looks into the patterns of specialization in production and trade among West African countries in order to have an idea of where Ghana's comparative advantage may lie. The last piece of the analysis compares levels of fertilizer use among West African countries to identify Ghana's position relative to its neighbors and potential competitors.

Regional trade can contribute to national food security if inter-country commodity flows reduce price fluctuations in local food and other agricultural markets. The preconditions for cross-border trade to contribute to stabilization of domestic markets is that production within individual countries be less stable than production for the whole group. This would happen in cases where national production fluctuations are negatively or incompletely correlated, meaning that domestic output shortages are likely to coincide with surpluses in neighboring

countries (see Koester 1986; Badiane 1988). Trans-border flows in this case would cause prices in the deficit (surplus) country to rise (fall) less.

Indicators of production instability during the period 1961 to 1986 in Ghana and other West African countries calculated in Badiane 1989 show a value of nearly 24 percent for Ghana and 15 percent for the whole region. The indicators are trend-corrected coefficients of variation which express the fluctuation over time of production in a given country around its trend value. The higher the coefficient of variation, the more unstable production is in the corresponding country. The figures cited above suggest a much higher degree of production instability for Ghana than for the average of the region. The stabilization gains deriving from increased cross-border trade for Ghana are reflected in the very low coefficients of correlation between fluctuations of its production and of production in other countries in the region that are presented in the right-hand column of table 6.1. These figures indicate that production shortfalls in Ghana are very likely to coincide with above-trend outputs in the other countries. Increased exchange with neighboring countries would therefore contribute to easing the effects of domestic production swings on local food markets in Ghana.

The potential and profitability of inter-country trade are primarily dictated by the degree of specialization among the considered group of countries. Indicators of the similarity of trade and production patterns between Ghana and all other West African countries have therefore been computed in order to have an idea of how far agricultural production structures in Ghana differs from that of the latter group of countries. The obtained coefficients are recorded in the first and second columns of table 6.1. They indicate the degree of similarity

between the patterns of trade and production in Ghana and in each of the other West African countries. The indicator value varies between 0 and 100. The higher (lower) its value, the more similar (dissimilar) are the trade or production patterns between Ghana and the considered country. Values of up to around 50 are conventionally interpreted as suggesting patterns of specialization that are compatible with high levels of intra-trade.

The coefficients indicate that Ghana has strong similarity of production structures mainly with Côte d'Ivoire and Cameroon. On the trade side, Nigeria is the only country that shows some significant similarity of specialization patterns with Ghana. For all the remaining countries, both coefficients have values in the range that would indicate some potential for Ghana to expand trade in agricultural commodities with its neighbors.

The ability to engage in beneficial inter-country trade would require Ghana to encourage production along the lines of its comparative advantages and to sustain the long term competitiveness of its exports relative to exports originating from other regional sources. Promoting the use of productivity-raising inputs such as fertilizer would contribute greatly to achieving that goal. However, as shown by the figures presented in table 6.2, Ghana is well behind many of its neighbors in terms of fertilizer consumption. Given the very modest levels of soil fertilization in Ghana as well as across all other West African countries, the differences cannot be explained by differences in fertilizer requirements. Only in the case of N fertilizer is the level of use in Ghana above the regional average (without Nigeria). And it still ranks fifth there behind Nigeria, Cameroon, Côte d'Ivoire and Senegal. It is important to note that the first three countries are those which were shown to have the

patterns of specialization that are the most similar to that of Ghana. In other words, these are its main potential competitors and are well ahead of Ghana in the use of key inputs such as fertilizer. In the cases of P_2O_5 and K_2O the rates of application in Ghana are significantly below the regional average, again with Nigeria excluded. It would seem clear that improvements in the fertilizer sector will be more than necessary if Ghana is to make more use of regional markets to raise and stabilize performance in its food and agricultural sector.

7. CONCLUSIONS

Cereals and tubers are the main foods consumed in Ghana. Expenditures on these items, together with other food products, account for a significant portion of expenditures by both poor and wealthier households in Ghana. Along with other agricultural activities, food production employs a large share of the labor force in the country. Fertilizer and other improvements can greatly contribute to short and long term food security in the country by raising the level of performance in the food and agricultural sector.

The use of fertilizer in Ghana's food and agricultural sector is very low and has not shown any significant upward trend since the early seventies. Moreover, the restricted amounts of fertilizer that are applied seem to be heavily concentrated on one single crop, maize, and to a lesser extent on rice. Other crops that are less commercialized, but that play a significant role in households food intake receive insignificant amounts of fertilizer. Furthermore, it appears that more than eighty percent of Ghanaian farmers do not use fertilizer at all. The bias in distribution and use of fertilizer in favor of maize and against non-maize growing areas can have serious effects on the exploitation of the country's comparative advantages, the long term growth potential in its agricultural sector and on food security.

The price environment that prevailed throughout the study period could not contribute to increasing fertilizer consumption. It has been characterized by falling or at best stagnating real producer prices and high levels of variability in the real costs of fertilizer across all major crops.

Ghana could use trading on regional markets to some extent to even out fluctuations on its local markets, stabilize food consumption and reduce risk in its domestic agricultural sector. All this would raise performance in the agricultural sector and raise food security in the short and longer run.

Ghana shows some degrees of specialization in trade and production vis à vis other West African countries which suggests a potential for inter-country trade in food and other agricultural commodities. Fertilizer use in Ghana is, however, lagging significantly below the observed levels in its main potential competitors on regional markets, namely Cameroon, Côte d'Ivoire and Nigeria.

TABLES

Table 2.1 Total availability of cereals and share of total imports and food aid imports 1983 - 1989

YEAR	Maize	Rice	% of Imports and Aid		% Aid Alone Rice
	(1000 mt)		Maize	Rice	
1983	160	64	38	70	19
1984	462	85	13	63	54
1985	340	98	11	56	34
1986	349	63	1	39	21
1987	397	99	3	61	23
1988	437	132	4	65	29
1989	500	84	0	62	49

Data Source: Ministry of Agriculture, PPMED, Accra.
Ministry of Finance and Economic Planning, IERD. Accra

Table 2.2 Regional Indices of consumption of Major Food Commodities

COMMODITY	Ghana	Western	Eastern	Volta	Ashanti	Northern	Upper
Maize	1.00	1.00	1.00	1.24	0.76	1.00	0.68
Rice	1.00	1.25	1.00	1.00	1.00	1.00	0.75
Millet-Sorghum	1.00	0.47	0.47	0.67	0.47	3.00	3.13
Cassava	1.00	1.11	1.11	1.11	1.11	0.81	0.81
Yam	1.00	0.97	1.13	0.89	1.13	1.13	0.89

Source: Report by FAO Crop Assessment Team 1987, (FAO/FPA/GH/88/P04). Rome.

For purposes of simplification, Western includes Central Region; Eastern includes Greater Accra Region, Ashanti includes Brong-Ahafo Region and Upper is made up of Upper East and Upper West Regions.

Table 2.3 Distribution of households by locality and by expenditure quintile

Expenditure Quintile	Accra	Other Urban	Rural	Percent on Food
First	3.55	16.38	23.35	70.41
Second	12.06	17.24	22.00	68.18
Third	12.06	21.84	20.54	66.06
Fourth	26.24	20.11	19.19	64.82
Fifth	46.10	24.43	14.92	55.48
Percent on Food[1]	48.00	41.00	30.00	53.48

Source: Rep. of Ghana (1988) Ghana Living Standards Survey, Statistical Service, Accra.

1. Excludes home-produced food.

Table 2.4--Distribution of households by expenditure quintile and by type of employment

Expenditure Quintile	Type of Government Army	Employment Private Firm	Self Employed	State Company
First	8.86	8.53	21.80	13.89
Second	15.38	9.30	22.34	30.56
Third	20.12	20.93	20.59	11.11
Fourth	24.26	23.26	19.82	19.44
Fifth	31.36	37.98	15.44	25.00

Source: Rep. of Ghana (1988) Ghana Living Standards Survey., Statistical Service, Accra.

Table 2.5--Labor force in agriculture, 1948 - 1984

Year	Total Employed	Total Engaged in Agriculture	Percentage of Agricultural Labor
1948	1,308,000	947,045	72.4
1960	2,559,383	1,581,273	61.8
1970	3,133,047	1,790,806	57.2
1984	5,422,480	3,288,808	60.7
1987	6,354,000	4,203,000	66.1

Source: Ghana Population Censuses (1948, 1960, 1970, 1984), Central Bureau of Statistics, Accra; and Ghana Living Standards Survey (1987)

Table 3.1--Major crops grown in the main agro-ecological zones

Zone	Category of Crops				
	Cereals	Roots/Tubers Plantain	Vegetables	Trees	Industrial
High Rain Forest	Maize Rice	Cassava Plantain/ Banana Cocoyam	Okro Pepper Gardeneggs	Citrus Coconut Oilpalm Rubber	NA
Semi-Deciduous Rain Forest	Maize Rice	Cassava Plantain/ Banana Cocoyam	Okro Pepper Gardeneggs	Cocoa Oilpalm Citrus Coffee	NA
Forest-Savanna Transition	Maize Rice Sorghum	Cassava Plantain/ Cocoyam Yam	Tomato Okro Pepper Gardeneggs	Coffee Citrus	Cotton Tobacco Kenaf Groundnut
Northern Savanna	Maize Rice Sorghum Millet	Yam Cassava	Tomato Onion	Sheabutter	Cotton Tobacco Kenaf Groundnut
Coastal Savanna	Maize Rice	Cassava	Tomato Shallot	Coconut	NA

Source : Compiled by authors

NA = not applicable

Table 3.2 Cereal production (five year averages) 1965 - 1990 (thousand metric tons)

Year	Maize		Sorghum		Millet		Rice		Total	
	Q	%	Q	%	Q	%	Q	%	Q	%
1965 - 69	278	(58)	89	(19)	73	(15)	41	(9)	481	(100)
1970 - 74	552	(56)	171	(21)	127	(16)	62	(8)	812	(100)
1975 - 79	304	(46)	152	(23)	134	(20)	69	(10)	659	(100)
1980 - 84	334	(51)	147	(22)	128	(19)	50	(8)	659	(100)
1985 - 89	573	(58)	182	(18)	155	(16)	82	(8)	992	(100)
1990	553	(65)	136	(16)	75	(9)	81	(10)	845	(100)

Data Source: Ministry of Agriculture, PPMED, Accra

Table 3.3 Percent area planted to and output of major cereals in agro-ecological zones of Ghana, 1987

Zone	Maize		Sorghum		Millet		Rice	
	Area	Output	Area	Output	Area	Output	Area	Output
Higher Rain Forest	9.4	7.3	0.0	0.0	0.0	0.0	7.6	7.1
Semi-deciduous Rain Forest	40.9	47.1	0.0	0.0	0.0	0.0	13.1	11.6
Forest-Savanna Transition	14.8	19.6	0.6	0.6	1.1	0.9	15.9	16.5
Northern Savanna	30.0	21.5	99.4	99.4	98.9	99.1	62.5	64.0
Coastal Savanna	4.9	4.5	0.0	0.0	0.0	0.0	0.9	0.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Data Source: Ministry of Agriculture, PPMED, Accra.

Table 3.4 Rice growing environments in the agro-ecological zones

Agro-ecological Zone	Growing Environment	
High Rain Forest	Valley bottom,	rainfed
Semi-deciduous Rain Forest	Valley bottom/ upland	rainfed
Forest-Savanna	upland	rainfed
Northern Savanna	upland/lowland	rainfed/irrigated
Coastal Savanna	lowland	irrigated

Source : Compiled by authors

Table 3.5 Production of roots, tubers and plantains (five year averages) 1965-1990 (000MT) *

Year	Cassava	Plantain	Cocoyam	Yam	Total
1965 - 69	1415 (34)	740 (18)	944 (22)	1107 (26)	4206 (100)
1970 - 74	2800 (43)	1809 (27)	1210 (18)	791 (12)	6610 (100)
1975 - 79	2198 (48)	993 (22)	777 (17)	569 (13)	4537 (100)
1980 - 84	2609 (48)	1144 (21)	1205 (22)	488 (9)	5446 (100)
1985 - 89	3059 (48)	1151 (18)	1046 (17)	1055 (17)	6311 (100)
1990	2717 (52)	799 (15)	815 (16)	877 (17)	5208 (100)

Source: Ministry of Agriculture, PPMED, Accra.

* Percentage in parentheses

Table 3.6 Percent area planted to and output of major starchy staples in crops in agro-ecological zones of Ghana, 1987

Zone	Cassava		Yam		Cocoyam		Plantain	
	Area	Output	Area	Output	Area	Output	Area	Output
High Rain Forest	11.8	11.7	5.7	3.6	15.1	16.4	12.8	11.6
Semi-Deciduous Rain Forest	58.6	56.8	20.9	20.6	68.6	67.8	68.3	68.0
Forest-Savanna Transition	19.2	22.1	25.5	31.4	16.3	15.7	18.9	20.4
Northern Savanna	3.9	4.1	47.9	44.3	0.0	0.0	0.0	0.0
Coastal Savanna	6.5	5.3	0.0	0.0	0.0	0.0	0.0	0.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Data Source: Ministry of Agriculture, PPMED, Accra.

Table 3.7 Production growth rates of staple crops 1970 TO 1990

Crop	1970-90	1970 - 80	1980 - 90	1970 - 75	1975 -80	1980 - 85	1985 - 1990
Maize	0.74	-2.66	5.62	-5.77	0.64	2.32	8.00
Sorghum	-1.34	-1.66	-1.28	-5.48	3.11	3.72	-5.30
Millet	-2.34	-0.38	-4.49	-2.92	2.30	-2.35	-7.50
Rice	3.27	2.73	2.66	8.98	-1.97	5.00	0.25
Cassava	0.69	2.13	-0.62	0.08	4.15	1.24	-2.33
Plantain	-2.57	-4.44	-1.42	-4.83	-5.04	9.00	-8.16
Cocoyam	-1.41	-2 54	-0.39	-0.65	-4.57	1.23	-1.89
Yam	-0.18	-4.22	6.70	-4.40	-5.19	1.33	11.32

Data Source: Ministry of Agriculture, PPMED, Accra.

Table 3.8 Quantity of rice imported

Year	Quantity (000m.t)	Year	Quantity (000 m.t)
1970	53.1	1980	43.0
1971	35.1	1981	27.9
1972	24.3	1982	52.7
1973	53.6	1983	65.9
1974	39.1	1984	50.4
1975	30.4	1985	30.0
1976	0.3	1986	2[illegible].0
1977	43.0	1987	60.0
1978	129.0	1988	48.0
1979	28.0	1989	24.7

Sources: West Africa Rice Development Association (1986) Price Statistics yearbook 6th Edition Monrovia; Ghana Ministry of Agriculture (1991) Agriculture in Ghana: Facts and Figures, PPMED, Accra. Asante E.O. et al (1989) Ghana: Grain Marketing Study, Min. of Agriculture/ The World Bank, Accra.

Table 3.9 Ghana rice self sufficiency five year averages

Period	Percent Self Sufficiency	Percent satisfied through imports
1960 - 64	28.8	71.2
1965 - 69	36.7	63.3
1970 - 74	48.3	51.7
1975 - 79	45.8	54.2
1980 - 84	41.2	58.2
1985 - 89*	53.9	46.1

Source: West Africa Rice Development Association (1986) Rice Statistics Year Book, 6th Edition, Monrovia Liberia.

* Estimated by Dr. V.K. Nyanteng ISSER, Univ. of Ghana, Legon.

Table 3.10 Per capita consumption of cereals in Ghana 1980 TO 1990

Cereal	1980		1985		1990	
	Kg	% total	Kg.	% total	Kg.	% total
Maize	38.4	45.3	39.2	45.9	40.3	45.7
Sorghum	17.0	20.0	17.1	20.0	17.3	19.6
Millet	17.0	20.0	17.1	20.0	17.3	19.6
Rice	12.4	14.7	12.0	14.1	13.3	15.1
	84.8	100.0	85.4	100.0	88.2	100.0

Source: Ghana Ministry of Agriculture (1991), Agriculture in Ghana: Facts and Figures, PPMED, Accra.

Table 3.11--Maize imported 1970 - 1990

Year	Quantity '000MT	Year	Quantity '000MT
1990	5.3	1980	12.6
1971	3.4	1981	27.0
1972	0	1982	81.7
1973	2.4	1983	61.8
1974	0.3	1984	38.0
1975	0.3	1985	0
1976	NA	1986	0
1977	NA	1987	10.0
1978	NA	1988	0
1979	NA	1989	0
		1990	0
		1991	0

Source : Ministry of Agriculture, PPMED, Accra.

Table 3.12 National consumer price indices combined and food 1970 - 1990 (1977 = 100)

Year	Combined	Food	Year	Combined	Food
1970	13.6	10.5	1980	401.2	392.5
1971	14.9	11.8	1981	868.7	828.8
1972	16.4	13.0	1982	1062.4	1125.4
1973	19.3	15.7	1983	2367.4	2754.6
1974	22.8	18.2	1984	3304.2	3058.5
1975	29.6	23.8	1985	3647.2	2717.7
1976	46.2	39.9	1986	4543.1	3268.8
1977	100.0	100.0	1987	6852.0	4527.1
1978	173.1	159.4	1988	8343.9	6071.0
1979	267.3	257.7	1989	10449.3	7593.8
			1990	14341.5	10642.0

Source: Rep. of Ghana (1978) Consumer Price Index Numbers (A New Series), C.B.S. Accra; Republic of Ghana (1991) Quarterly Digest of Statistics, Statistical Service, Accra.

Table 3.13 Contributions to increase in consumer price index by components (1970 - 1977)

Year	Combined (100)	Local Food (52.1)	Imported Food (3.0)	Drinks and Tobacco (5.3)	Fuel and Light (8.0)	Clothing (13.8)	Health and Hygiene (4.41)	Trans-port/ Communi-cation (3.5)	Durable Goods (1.5)	Rent (2.2)	Misc. (6.2)
1970	100.0	82.2	-0.8	-5.8	6.0	10.6	1.3	4.0	0.5	0.0	2.0
1971	100.0	77.8	-0.6	3.6	2.6	6.8	4.0	0.5	1.2	0.0	4.1
1972	100.0	60.7	5.7	3.0	7.6	7.7	5.6	3.7	2.5	0.1	3.5
1973	100.0	70.7	2.2	2.6	6.0	9.2	2.3	0.1	1.6	0.0	5.1
1974	100.0	51.9	3.5	3.2	9.9	14.8	5.5	4.2	2.2	0.0	4.8
1975	100.0	58.3	3.0	9.2	6.0	12.9	1.9	2.0	1.6	0.0	5.1
1976	100.0	77.5	0.6	0.5	5.3	10.0	0.6	0.9	1.4	0.0	3.2
1977	100.0	86.4	1.4	1.5	3.5	4.6	0.9	0.3	0.6	0.0	0.9

Source: Calculated by V.K. Nyanteng, ISSER, Legon using a formula:

$$C' \left(\frac{\left(yi \times \frac{Weight}{100} \right)}{\left(\left(yi \times \frac{Weight}{100} \right)} \right) \times 100$$

Table 3.14--Contributions to increase in consumer price index by components 1978 to 1990

Year	Combined (100.0)	Food (49.2)	Beverage and Tobacco (6.2)	Clothing and Footwear (19.2)	Gross Rent Fuel & (6.8)	Furn. Furn. Househld Equip. (5.1)	Med. Care and Health (1.8)	Transp. and Comm. (4.3)	Recreation Education etc. (5.5)	Misce. Goods and Services (1.9)
1978	100.0	40.0	12.0	12.0	4.4	6.6	1.7	3.5	5.5	2.1
1979	100.0	51.5	5.1	5.1	2.9	4.6	2.1	4.0	8.3	2.8
1980	100.0	49.4	9.1	9.1	5.6	7.3	2.1	4.8	3.7	1.6
1981	100.0	45.9	8.8	8.8	5.1	8.0	1.1	3.6	4.0	1.9
1982	100.0	75.4	-3.8	-3.8	1.5	11.5	2.5	0.2	7.8	2.7
1983	100.0	61.6	5.9	5.9	5.4	14.6	1.4	2.7	1.6	1.6
1984	100.0	15.9	10.6	10.6	10.3	12.7	2.2	6.7	7.3	3.4
1985	100.0	-49.0	16.2	16.2	4.6	9.5	5.0	20.9	28.5	5.9
1986	100.0	30.3	10.9	10.9	10.9	8.1	1.3	7.8	5.4	2.0
1987	100.0	34.2	8.4	8.4	7.3	8.1	1.1	5.2	5.9	1.7
1988	100.0	38.1	8.3	8.3	8.2	6.7	1.5	5.6	4.9	2.5
1989	100.0	35.6	9.2	9.2	7.4	6.6	0.9	6.9	7.8	2.0
1990	100.0	38.5	7.5	7.5	10.2	6.4	1.4	8.0	6.5	1.9

Source: Calculated by V.K. Nyanteng, ISSER, Legon using a formula:

$$C' \left(\frac{yi \times \frac{Weight}{100}}{\left(yi \times \frac{Weight}{100} \right)} \right) \times 100$$

Table 4.1 Trends in average yield of major annual crops, 1970 - 1990 (MT/HA)

Year	Maize	Rice	Millet	Sorghum	Cassava	Yam	Cotton
1970	1.1	0.9	0.6	0.8	6.8	5.3	0.5
1971	1.1	NA	0.6	0.7	6.8	5.3	1.1
1972	1.0	NA	0.6	0.8	7.5	5.1	0.5
1973	1.0	NA	0.6	0.8	7.7	4.7	0.6
1974	1.1	NA	0.6	0.7	9.5	6.4	0.7
1975	1.1	NA	0.6	0.6	8.4	4.0	0.7
1976	1.0	NA	0.6	0.8	7.3	5.7	0.5
1977	1.1	1.0	0.7	0.7	8.2	5.8	0.4
1978	1.0	1.0	0.6	0.7	8.2	5.5	0.5
1979	1.0	1.0	0.6	0.8	8.3	5.2	0.5
1980	1.1	1.0	0.6	0.8	7.5	5.5	0.2
1981	1.1	1.0	0.6	0.8	8.1	5.3	0.2
1982	1.0	0.8	0.5	0.5	7.2	4.7	0.2
1983	0.5	0.7	0.5	0.5	5.7	4.7	0.2
1984	0.8	1.1	0.6	0.7	12.9	3.3	0.2
1985	1.0	0.9	0.5	0.7	8.6	5.0	NA
1986	1.2	0.9	0.7	0.7	7.4	5.9	0.4
1987	1.1	1.1	0.7	0.8	7.0	5.6	0.4
1988	1.1	2.0	0.8	0.7	7.4	5.9	0.4
1989	1.3	0.9	0.9	0.7	0.7	6.3	6.3
1990	1.2	1.7	0.6	0.7	7.4	5.9	NA
Average	1.1	1.1	0.6	0.7	7.9	5.1	0.6

Data Source: Ministry of Agriculture (1991) Agriculture in Ghana: Facts and Figures, (Policy Planning, Monitoring and Evaluation Department).

NA = Not Available

Table 4.2 Productivity Gaps and Fertilizer Use

	Traditional Yields (kg/ha)	Progressive[1] Yields (kg/ha)	Potential[1] Yields (kg/ha)	Fertilizer Response Coefficients[2]
Maize	1,200	2,400	5,000	5 - 15
Millet	400	800	2,000	10 - 20
Cassava	5,000	7,000	28,000	20 - 30
Rice	1,000	2,000	3,000	5 - 10

Source: Robert Nathan Associates 1988; and Lele et al, 1989, MOA (1991)

1) At agricultural research stations in Ghana.

2) These are examples of coefficients obtained for humid and sub-humid zones in Cameroon. Figures represent kg output per kg of applied nutrients.

Table 4.3 Five year average yield of major crops by region, (1987 - 1991)

REGION	MAJOR CROPS (tons/hectares)					
	Maize	Rice	Millet	Sorghum	Yam	Cassava
Western	1.08	0.97	-	-	4.67	7.46
Central	1.33	1.03	-	-	4.06	7.52
Eastern	1.68	0.98	-	-	6.87	7.41
Greater Accra	1.17	0.67	-	-	-	6.37
Volta	1.29	1.43	-	-	6.19	7.56
Ashanti	1.29	0.97	-	-	5.46	9.15
B. Ahafo	1.62	1.10	-	-	6.28	9.76
Northern	0.90	1.21	0.84	0.80	6.17	7.92
Upper West	0.89	0.92	0.80	0.84	5.75	-
Upper East	0.57	1.03	0.59	0.06	-	-

Data Source: Ministry of Agriculture, PPMED, Accra.

Table 4.4 Contribution to major crop production by region, (Five year average, 1987 - 1991)

REGION	MAJOR CROPS (PERCENTAGES)					
	Maize	Rice	Millet	Sorghum	Yam	Cassava
Western	6.92	8.96	-	-	3.04	10.75
Central	10.97	3.40	-	-	1.06	10.30
Eastern	16.59	4.50	-	-	7.52	20.37
Greater Accra	2.47	0.48	-	-	-	2.68
Volta	6.95	4.23	-	-	5.40	7.69
Ashanti	15.20	6.30	-	-	8.35	21.05
Brong Ahafo	19.07	16.30	-	-	25.08	24.06
Northern	16.42	37.97	51.30	48.25	42.62	3.10
U. West	5.05	8.09	22.23	31.13	6.93	-
U. East	0.36	9.43	26.37	20.72	-	-

Data Source: Ministry of Agriculture, PPMED, Accra.

Table 5.1 Fertilizer Cost and Subsidies 1970-1990 (Cedis/MT)

	Compound				Ammonium Sulphate			
Year	Cost	Sales Price	Subsidy	% Subsidy	Cost	Sales Price	Subsidy	% Subsidy
1970	110.60	56.00	54.60	49	81.40	40.00	41.40	51
1971	122.30	56.00	66.30	54	85.60	40.00	45.60	54
1972	163.90	56.00	107.90	66	110.70	40.00	70.70	64
1973	183.20	56.00	127.20	69	155.20	40.00	115.20	74
1974	353.70	56.00	297.70	84	293.10	40.00	253.10	86
1975	408.60	56.00	352.60	86	275.60	40.00	235.60	85
1976	297.50	56.00	241.50	81	227.50	40.00	187.50	82
1977	306.00	130.00	176.00	58	296.00	100.00	196.00	66
1978	NA	150.00	NA	NA	NA	120.00	NA	NA
1979	1000.00	200.00	800.00	80	850.00	170.00	680.00	80
1980	857.14	300.00	557.14	65	685.71	240.00	445.71	65
1981	1090.91	600.00	490.91	45	909.00	500.00	409.00	45
1982	1090.91	600.00	490.91	45	909.00	500.00	409.00	45
1983	2109.09	1160.00	949.09	45	1636.36	900.00	736.36	45
1984	16000.00	8800.00	7200.00	45	10227.00	5900.00	4827.27	45
1985	22000.00	8800.00	13200.00	60	14750.00	5900.00	8850.00	60
1986	35454.54	15600.00	19854.54	56	22272.73	9800.00	12472.73	56
1987	47586.21	27600.00	19986.21	42	28275.86	16400.00	11875.86	42
1988	65714.28	46000.00	19714.28	30	33371.43	32000.00	1371.43	30
1989	78823.52	67000.00	11823.52	15	47899.41	47000.00	829.41	15
1990	84000.00	84000.00	0.00	0	62000.00	62000.00	0.00	0

Source: Stryker, J.D. et al. 1990; Jebuni C.D and Seini, A.W. (1992); ISSER Databank.

Table 5.2 Stability and level of real crop prices

Year	Maize	Millet	Cassava	Rice	Fertilizer
1970	88.48	117.97	29.49	182.86	17.92
1971	80.70	121.05	33.62	172.83	17.30
1972	104.04	122.40	36.72	208.50	15.17
1973	93.35	129.66	31.11	216.27	13.02
1974	87.42	126.77	30.60	200.21	10.81
1975	84.53	98.05	37.19	212.34	9.13
1976	123.26	155.70	49.73	278.53	5.90
1977	119.00	159.00	59.00	181.70	5.88
1978	77.43	107.49	31.78	143.20	3.93
1979	62.51	83.47	24.70	105.40	3.50
1980	103.24	123.69	34.41	148.78	3.50
1981	89.15	101.13	39.04	134.26	3.31
1982	75.05	117.89	36.63	182.73	2.79
1983	163.03	191.47	63.26	260.09	2.31
1984	70.78	134.31	25.61	203.16	11.75
1985	55.90	89.58	21.80	142.81	11.26
1986	72.88	88.50	31.01	135.90	10.78
1987	84.80	84.54	50.12	167.36	15.08
1988	82.20	104.91	32.16	233.13	21.80
1989	54.95	102.05	23.89	173.91	24.76
1990	140.19	77.03	30.43	125.82	19.89
CV	0.29	0.24	0.30	0.24	0.61
R	-0.21	-0.36	-0.40	0.04	1.00

Source: MOA, PPMED, Statistics Division

Table 6.1 Patterns of specialization and correspondence of production fluctuations between Ghana and other West African countries

	Similarity of Trade Patterns [1]	Similarity of Production Patterns [1]	Correlation of Production Fluctuation [2]
Benin	27.15	57.70	0.39
Burkina Faso	0.33	46.80	0.38
Cameroon	38.94	64.21	0.23
Chad	0.00	49.13	-0.32
Côte d'Ivoire	51.08	66.64	0.52
Gambia	0.00	37.74	0.35
Guinee	25.58	47.31	0.52
Guinee Bissau	0.42	49.57	0.15
Liberia	33.56	38.61	0.56
Mali	0.31	50.30	0.38
Mauritania	0.00	37.71	-0.32
Niger	0.32	43.85	-0.24
Nigeria	91.20	56.55	0.30
Senegal	0.34	42.75	0.29
Togo	18.23	57.42	0.65

Source: O. Badiane, 1989.

1) see Badiane 1989 for calculation of trade and production similarity indicators.

2) Coefficients are for cereals production. Coefficients of variation for production in Ghana and the rest of the region (including Ghana and the sample of countries above) are, respectively, 23-68 and 14.73.

Table 6.2 Level of fertilizer use in Ghana and neighboring West African countries (1988/89)

Countries	N	P_2O_5 (1000 mt)	K_{20}
Benin	4.0	3.0	1.6
Burkina Faso	6.3	5.4	3.4
Cameroon	21.5	7.3	6.5
Côte d'Ivoire	8.2	8.0	25.0
Gambie	1.4	1.3	0.8
Ghana	7.0	2.8	2.8
Guinee	0.3	0.1	0.3
Liberia	1.6	0.1	1.7
Mali	9.0	3.4	1.0
Mauritania	2.0	0.6	0.6
Niger	1.1	0.2	0.2
Nigeria	160.0	100.0	52.0
Senegal	8.0	10.0	8.0
Sierra Leone	0.1	-	0.1
Togo	5.2	1.8	3.0

Source: Afrique Agriculture, 173, mai 1990.

FIGURE 3.1 INDICES OF TOTAL AND PER CAPITA FOOD PRODUCTION (1974–1990)

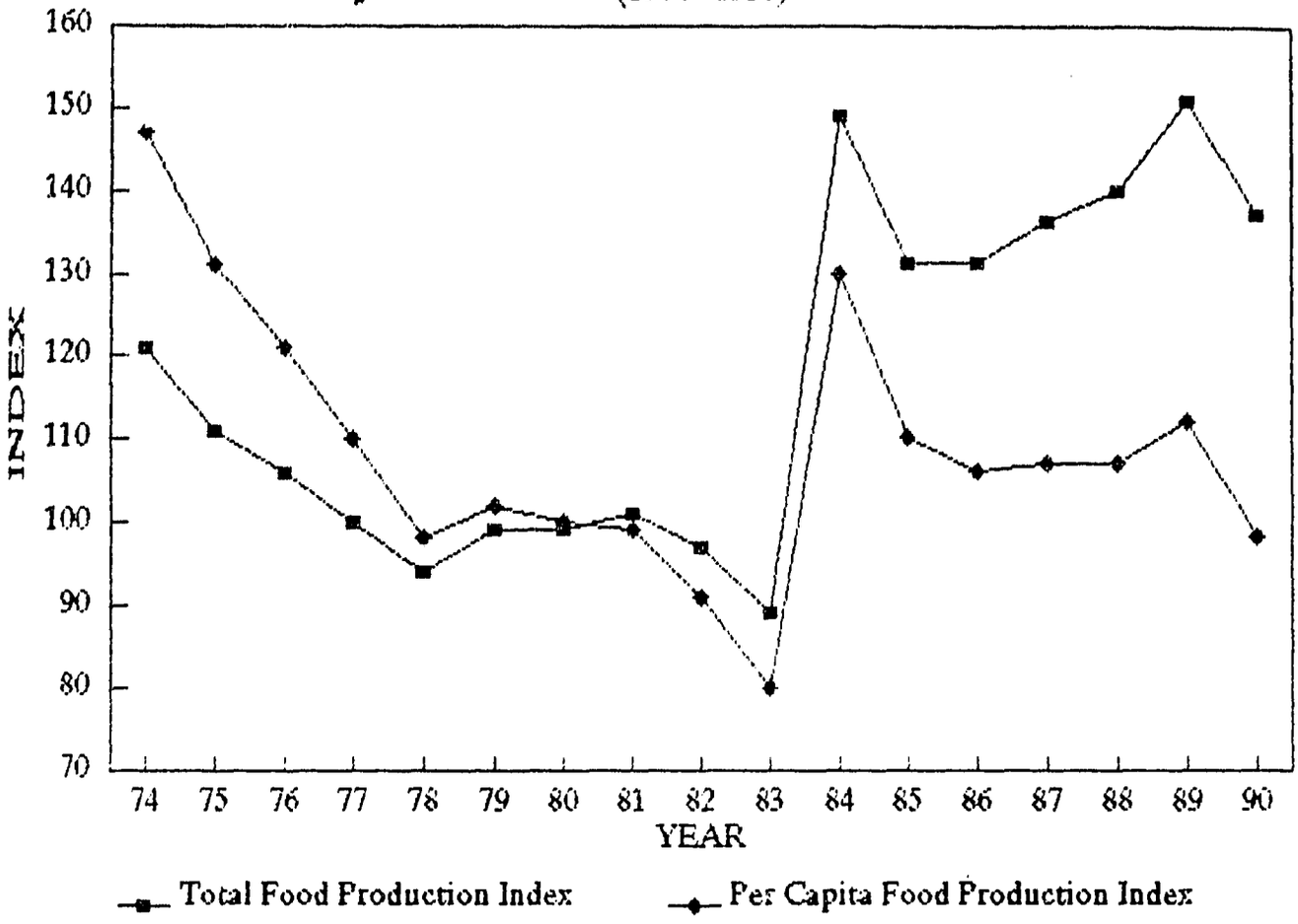


Figure 3.2 INDICES OF TOTAL AND PER CAPITA CEREAL PRODUCTION (1974–1989)

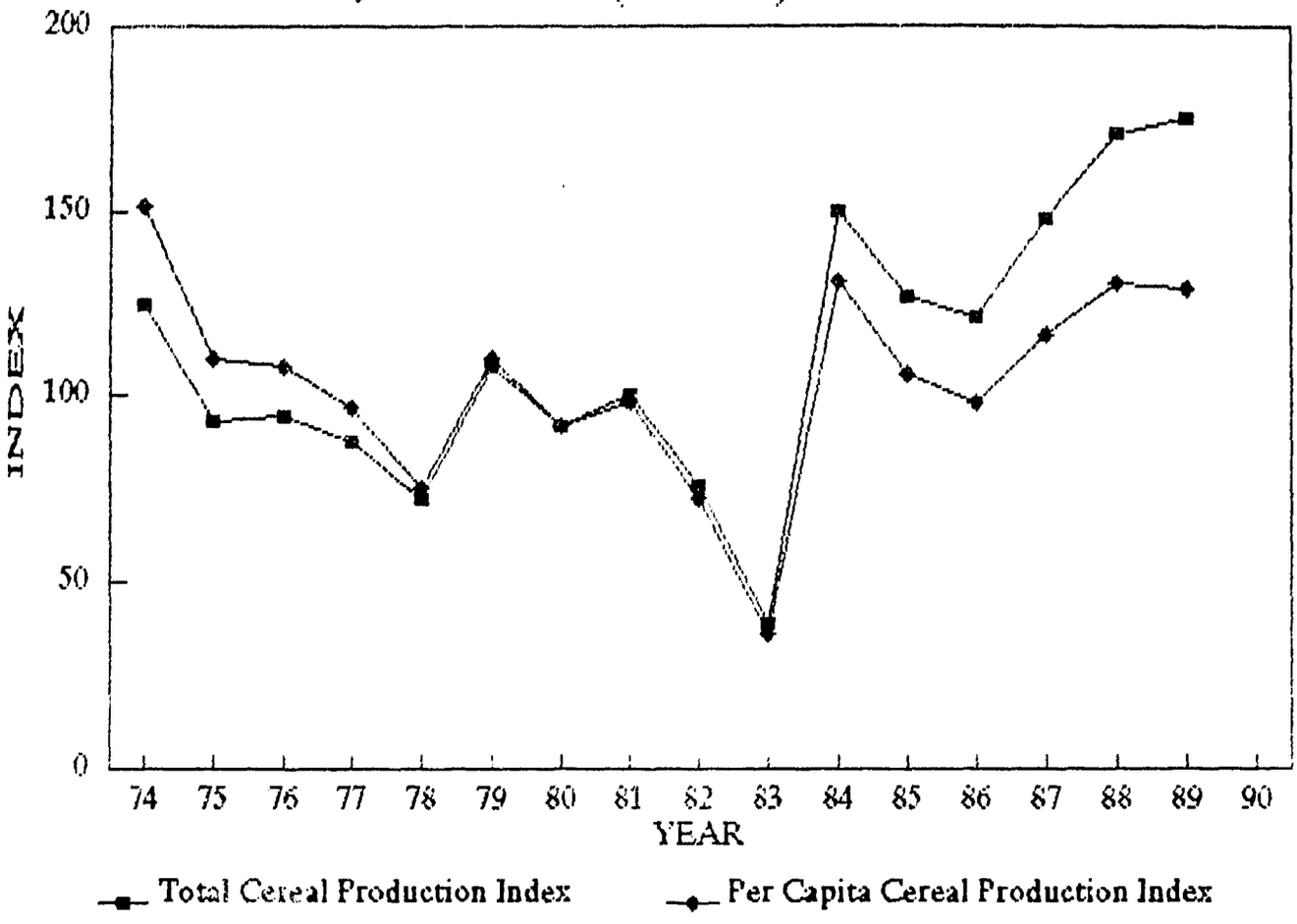


Fig. 3.3

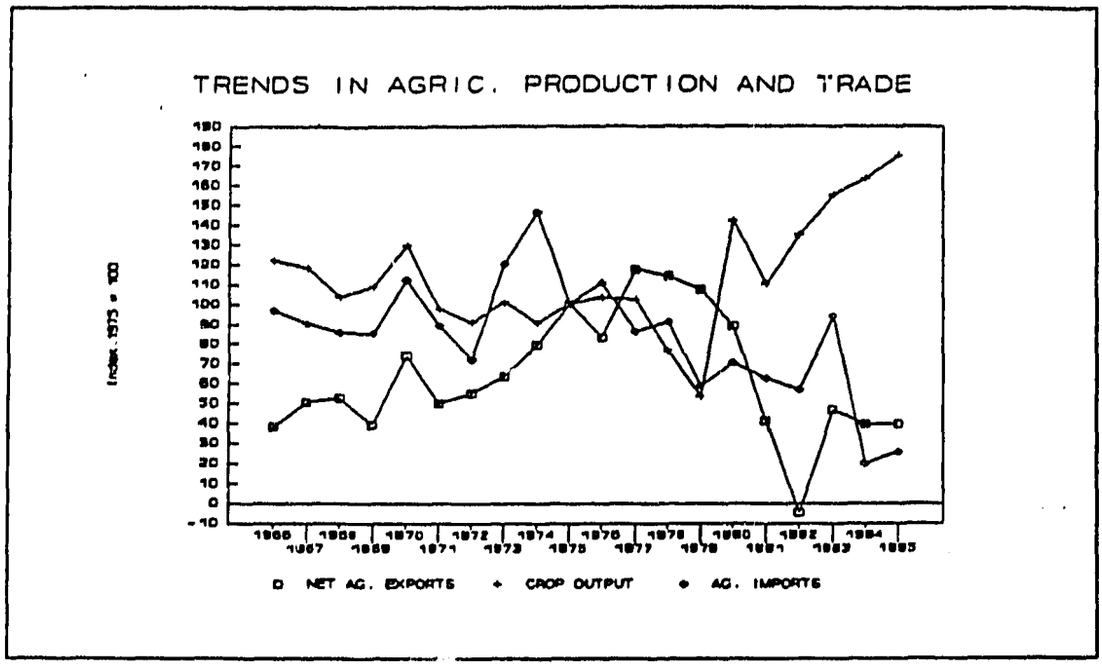

TRENDS IN AGRIC. PRODUCTION AND TRADE
NET AG. EXPORTS
CROP OUTPUT
AG. IMPORTS

Fig. 4.1

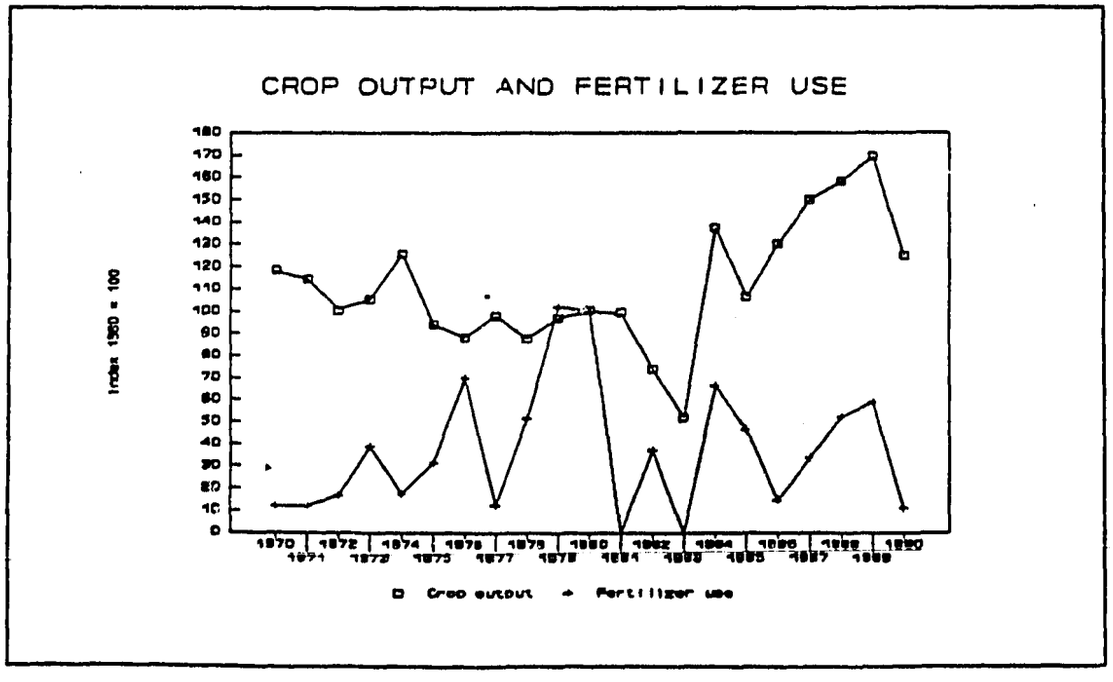

CROP OUTPUT AND FERTILIZER USE
Crop output
Fertilizer use

Fig. 5.1

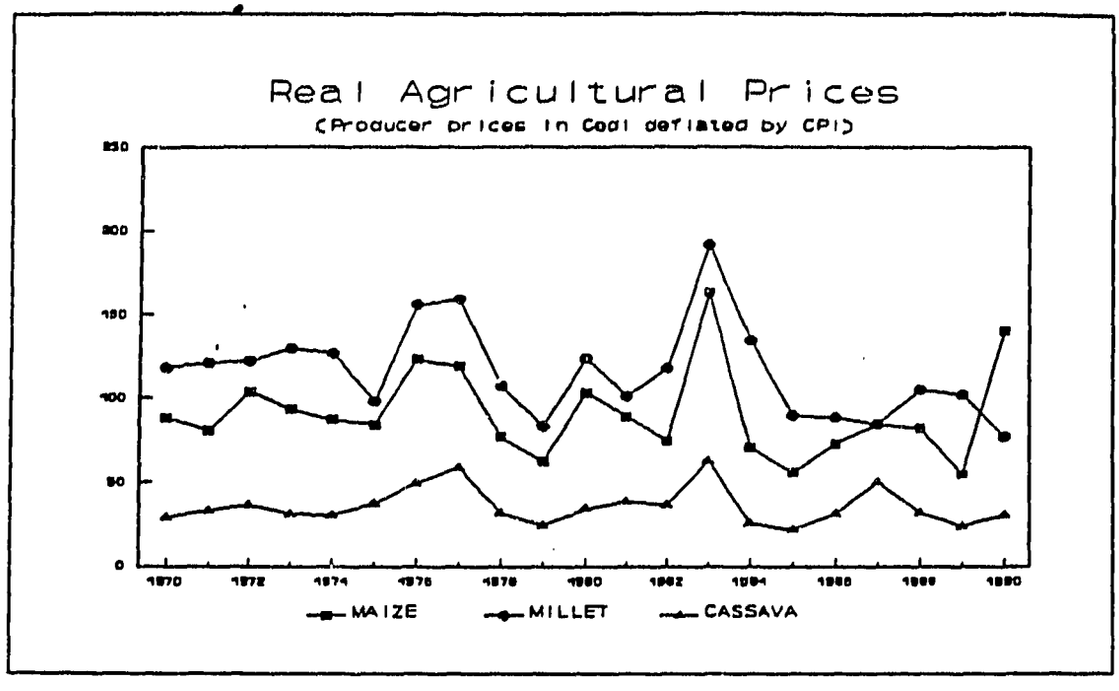
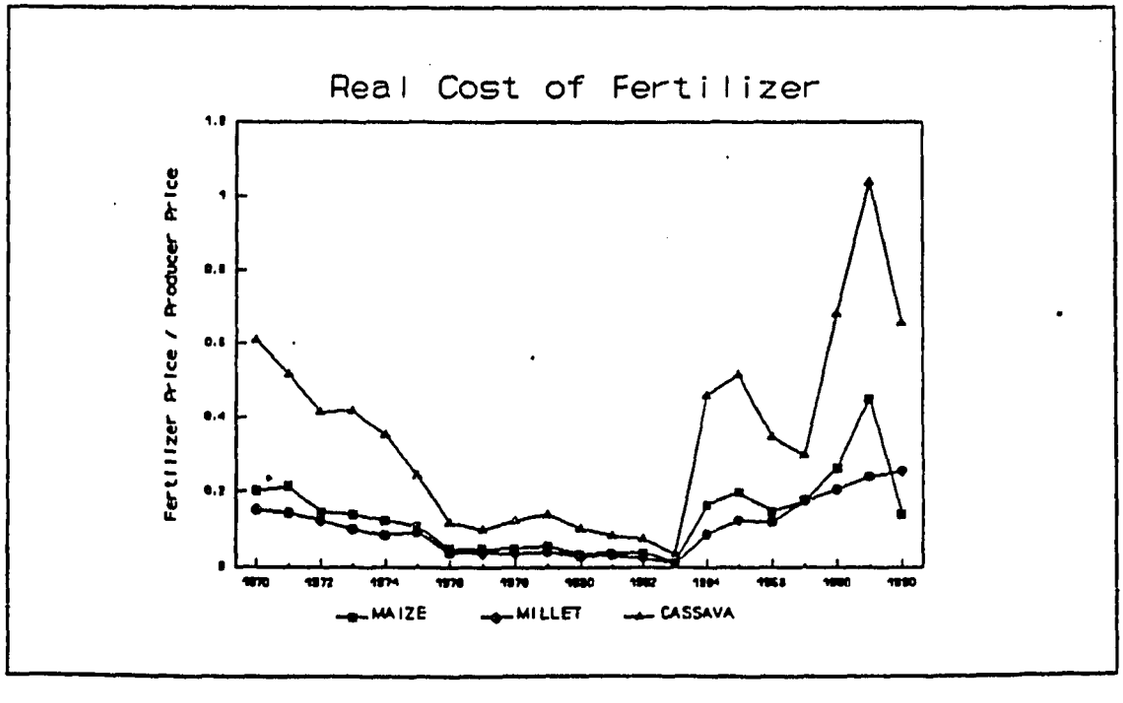

Real Agricultural Prices
(Producer prices in Cedi deflated by CPI)
MAIZE
MILLET
CASSAVA

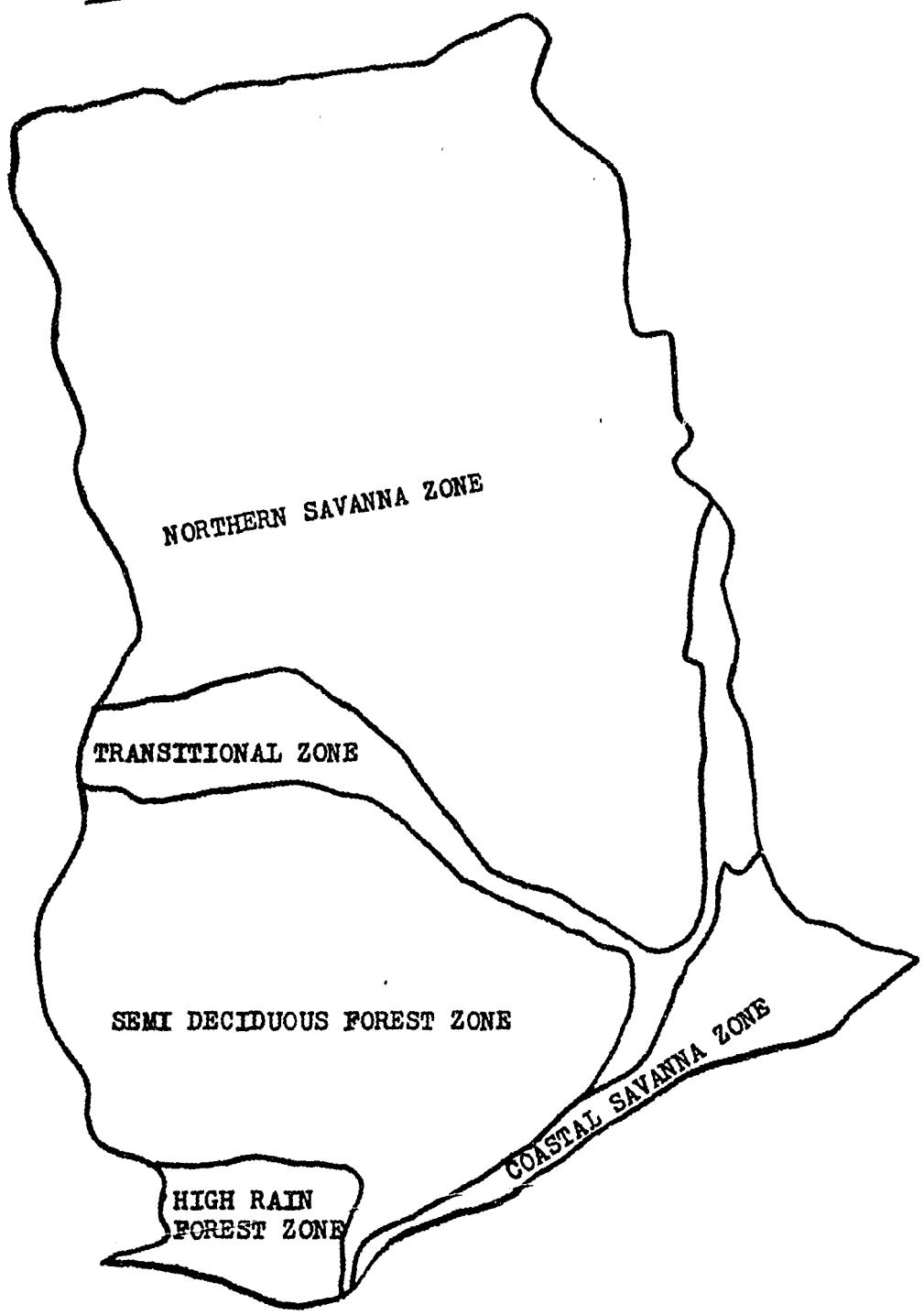
Fig. 5.2


Real Cost of Fertilizer
Fertilizer Price / Producer Price
MAIZE
MILLET
CASSAVA

MAPS

MAP 1

AGRO-ECOLOGICAL ZONES OF GHANA



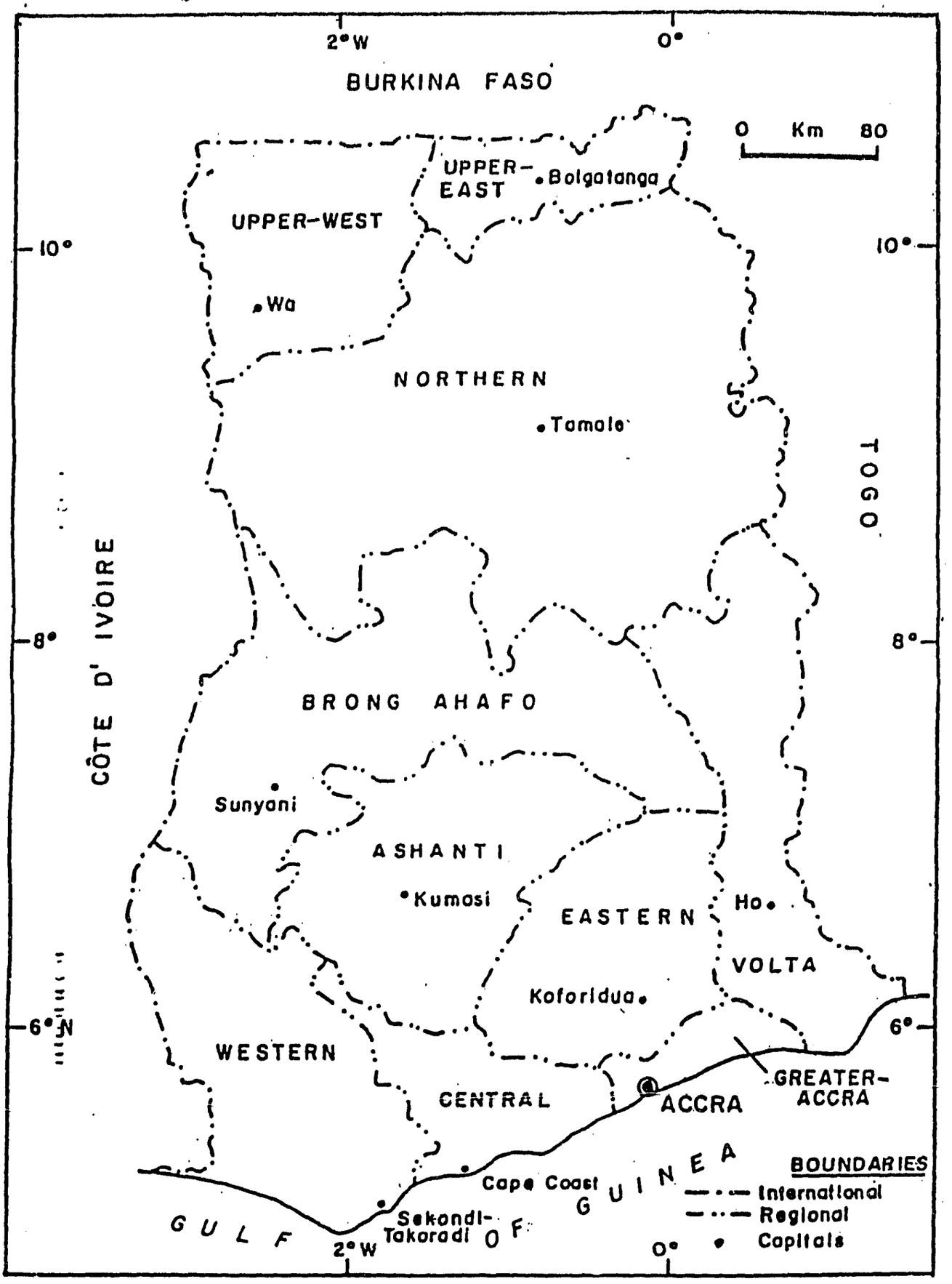


Fig. 2 The Administrative Regions of Ghana

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APPENDIX

CLIMATIC CONDITIONS OF AGRO-ECOLOGICAL ZONES

Zone	Area		Location	Rainfall (mm)		Rainfall Pattern	Rainfall Season*	
	Major	Minor		Sq. Km.	% Total		Average Season	Range Season
.. High Rain Forest	9500	4	S-W corner of Western Region	2200	1800-2800	Bi-modal	March to July (1500)	October to November (366)
?. Semi Decidous Rain Forest (Sefwi-Bekwai)	50,000	21	Most parts of Central and Western Regions and parts of Eastern, Volta, Ashanti and Brong Ahafo Region.	1400	1200-1600	Bi-modal	March to July (802)	September to October (315)
›. Forest Savanna Transition (Wenchi)	26,200	11	Parts of Ashanti, Brong Ahafo and Eastern and Volta Regions.	1200	1100-1400	Bi-modal	March to July (670)	September to October (396)
·. Coastal Savanna (Ada)	16,700	7	Parts of Central, Greater Accra, and Volta Region	800	600-1200	Bi-modal	March to July (689)	September to October (129)
·. Guinea Savanna (Tamale)	127,900	54	Parts of Brong Ahafo, Northern, Upper West Regions	1100	1000-1200	Uni-modal	May to September (847)	NA
·. Sudan Savanna (Navrongo)	7,200	3	Parts of Upper West, Northern and all of Upper East Region	800	500-1000	Uni-modal	NA	NA

Appendix (Cont'd)

Zone	Rainy Days (No.)			Rainy Days per month		Dry Period*		Rainy Days		Rainy Days/month	
	Total	Major	Minor	Major Season	Minor Season	Long	Short	Long Dry Season	Short Dry Season	Long Dry Period	Short Dry Period
1. High Rain Forest	160	80	33	10-23	15-18	Dec. to Feb. (202)	Aug. to Feb. (146)	19	27	4-9	12-15
2. Semi Decidous Rain Forest (Sefwi-Bekwai)	134	69	32	10-20	15-17	Nov. to Feb. (173)	Aug. (78)	18	15	2-8	15
3. Forest Savanna Transition (Wenchi)	116	58	36	9-15	17-19	Nov. to Feb. (116)	Aug. (74)	14	8	1-7	8
4. Coastal Savanna (Ada)	67	32	8	7-14	8	Nov. to Feb. (90)	Aug. (21)	8	3	1-3	3
5. Guinea Savanna (Tamale)	95	68	NA	10-18	NA	Oct. to April (252)	NA	27	NA	1-11	NA
6. Sudan Savanna (Navrongo)	84	66	NA	8-17	NA	Oct. to April (87)	NA	18	NA	1-7	NA

Appendix (Cont'd)

Zone	Temperature (°C)					Average Relative Humidity (%)		Average Sunshine Hrs/Day		
	Average per yr.	Average max.	Average minimum	Hottest Month/s	Coolest month/s	Morning	Afternoon	Major Rainy Season	Minor Rainy Season	Cloudiest Period
1. High Rain Forest	26.4	29.3	23.4	Feb. to May (27-28)	August (25)	92	77	7.4-3.5	5.8-7.4	June to September (3.3-4.1)
2. Semi Decidous Rain Forest (Sefwi-Bekwai)	27	38.9	22.2	Jan to May (28-29)	(26)	94	63	6.0-3.2	3.3-4.8	July to September (2.7-3.3)
3. Forest Savanna Transition (Wenchi)	26	38.9	20.9	Feb. to April (27-28)	July to Sept. (24-25)	93	60	7.1-4.0	4.3-5.4	July to Sept. (3.5-4.3)
4. Coastal Savanna (Ada)	27.6	30.7	24.5	Nov. to May (28-29)	July to Sept. (25-26)	92	76	7.0-4.5	6.0-7.2	June to August (4.5 to 5.5)
5. Guinea Savanna (Tamale)	28.0	33.6	22.3	Feb. to April (30-31)	Aug. to Sept. (26)	77	46	8.0-4.8	NA	July to September (4.8-5.8)
6. Sudan Savanna (Navrongo)	28.5	34.3	22.3	March to May (30-32)	July to Sept. (26-27)	69	39	8.2-5.5	NA	July to September (5.5-6.7)

Source: Compiled by the authors from several sources.

*Amount of rainfall (min) in brackets