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Fertilizer Use in Ghana
A Study of Farm-Level Constraints

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SUMMARY

This policy oriented study was set out to identify the economic factors which constrain the increased use of fertilizers in Ghana. The study examined various aspects of fertilizer use in all six agro-ecological zones that form the country. Most of the fertilizers used in the country is on cereals, mainly maize, rice and sorghum. The production of these crops is located largely in the northern half of the country, comprising of Guinea Savanna, Sudan Savanna and Transitional zones. About 69.2 percent of the fertilized land area surveyed was located in these zones which also accounted for approximately 76.3 percent of the volume of fertilizer nutrients used in Ghana in the 1991 crop year.

A comparison of the rates of fertilizer nutrient application per acre of fertilized land area with the recommended rates for selected crops, reveals a gap in most instances. In the Rain Forest, Semi-Deciduous forest and Coastal Savanna zones, maize on continuously cropped land received only 58.4, 42.0 and 67.9 percent of the recommended rates, respectively. In the Transitional, Guinea Savanna and Sudan Savanna zones, the amount of fertilizer nutrients applied to maize per acre of fertilized land was 66.2, 106.6 and 82.6 percent of the recommended amounts, respectively.

About 15 different types of fertilizer were used in the 1991 crop season, ranging from 3 in the Rain Forest to 8 in the Sudan Savanna.

Three types of fertilizer were most widely used: NPK (15-15-15) supplies about 47.7 percent of the total fertilizer nutrients; Ammonium Sulphate (21-0-0) accounted for 22.3 percent; while another 14.8 percent of the total fertilizer nutrients came from NPK (20-20-0).

The study analyzed the agro-economic potential of fertilizer use, this potential being the highest level of returns to fertilizer that can be obtained under the ideal technical and economic conditions. The agro-economic potential of fertilizer use could be approximated to the highest returns that can be derived from fertilizer use given the prevailing technical and economic conditions. These returns are a function of the crop response to fertilizer and the farm level fertilizer-crop price ratio.

The study indicates that most crops produced in Ghana respond significantly to fertilizer use. Maize response varies from 6.9 kgs of grains per kg of NPK in Brong Ahafo to 18.6 kgs in the Volta Region. The response of rice to fertilizer in the Volta Region and the Northern Region varies between 13.5 kgs to 18.5 kgs of paddy per kg of NPK nutrients. Cassava has the highest response to fertilizer input; about 120 kgs of fresh cassava tuber per kilogram of NPK nutrients was produced in the Volta Region. Sorghum, soybean and cotton also respond well to fertilizer use.

The cost of fertilizer use, expressed in terms of crop output needed to purchase a kilogram of fertilizer nutrients, varies from 1.5 kgs to 3.9 kgs for maize. These costs appear to increase from south to north. For rice, costs vary from 1.0 kg to about 1.8 kgs. For sorghum, the farm level terms of trade between fertilizer and the crop vary from

1.6 kgs to 2.9 kgs. Costs of fertilizer use in the north are lower for sorghum than for maize. It is the combination of import and export duties imposed on agricultural commodities; domestic fertilizer and crop marketing costs; and fertilizer and crop world market prices that determines the observed terms of trade between fertilizer and crops in Ghana.

The use of fertilizer on maize, rice and sorghum is significantly profitable in the agro-ecological zones where they are produced. Since the crop responses to fertilizer and the fertilizer-crop terms of trade are the key determinants of the level of agro-economic potential, efforts need to be deployed in order to improve these parameters. First, actions must be taken to increase crop responses to fertilizers through widespread use of appropriate fertilizer use practices and other agricultural techniques. For these objectives to be achieved, there is need to improve the quality of both research and extension services. Second, measures are to be initiated to rationalize fertilizer imports, to improve fertilizer and crop marketing and to expand credit markets and other related services.

CHAPTER 1

INTRODUCTION

1.1 Background and Justification

Agronomic research conducted on various crops in different agro-ecological zones in Ghana indicates that the contribution of fertilizers to farm output can be substantial. A recent study (Henao and Dennis, 1992) reports that many crops significantly respond to fertilizer use in various agro-ecological zones of Ghana. However, despite this potential, the number of farmers using fertilizers and the number of crops fertilized remain limited. A recent IFDC study in the Ashanti Region indicates that fertilizer use is minimal and is limited to vegetables and maize. Out of a sample of 121 farmers only 14 percent used fertilizer[1].

All the fertilizers used in Ghana is imported; annual imports and changes in such imports thus provide a good indication of the level of fertilizer use and trends. Total imports of fertilizer into Ghana averaged a mere 1403 mt per year between the years 1954 and 1962. Imports rose to 6683 mt per year over the next decade and jumped to 32,731 mt between 1973 and 1980. The actual quantities brought into the country

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[1] IFDC (International Fertilizer Development Center) 1989. Fertilizer Investment for Soil Fertility Restoration Project - Progress report. Muscle Shoals, Alabama, U.S.A.

fluctuated markedly from year to year. Indeed no imports of fertilizer occurred in some years, such as 1981 and 1983. Generally, imports of the input have increased in recent years to average 39,381 mt per year between 1984 and 1990. Total quantities of fertilizer imported each year nonetheless, remain insignificant compared with the total cultivated area of approximately 4.32 million hectares (Ghana, 1991).

Farming in Ghana remains largely traditional. For example, an exhausted farmland is left in fallow to restore its fertility--the longer the fallow, the higher the level of fertility. This system of restoring soil fertility worked well in the past but is proving increasingly difficult. Rapid population growth has reduced per capita arable land in most places. This gives rise to shortened fallow periods, and makes fallowing less effective in restoring soil fertility. The result is low crop yields and reduced total output in many instances.

To reverse the trends, technological transformation of the agriculture, embodied in widespread use of fertilizer associated with improved seeds and pesticides. This is seen by policy makers in the country as one of the key ingredients in the process of agricultural and overall economic development. The promotion of widespread use of fertilizer and complementary inputs calls for appropriate policies from the government. Such policies are only possible after policy makers have acquired a good understanding of the various factors constraining the widespread use of the input. This study attempts to contribute to such an understanding.

1.2 Objectives and Plan of the Study

This study identifies and assesses the main economic constraints that prevent farmers from taking advantage of the potential provided by mineral fertilizers. Put differently, the study examines the key economic factors that limit the use of fertilizers on different crops in the various agro-ecological zones or regions of Ghana. Specifically, the study focuses on four points. These points are organized into core chapters of the study.

Chapter II develops the analytical framework used in this study to estimate the agro-economic potential of fertilizer use and to assess its determinants. Chapter III describes different agro-ecological zones of Ghana, the main crops produced therein and presents the allocation of fertilized land area between various crops. The Chapter also examines the distribution of fertilizer nutrients among different crops in various agro-ecological zones of the country. Furthermore, the Chapter estimates the rates of fertilizer nutrient application on these crops, presents the different fertilizer types used in Ghana, and makes some policy inferences.

Chapter IV reports the estimates of crop responses to fertilizer use in various agro-ecological zones of Ghana, examines the fertilizer-crop terms of trade, and provides some estimates of the agro-economic potential of fertilizer use on selected crops. Chapter V critically analysis various non-price factors affecting the use of fertilizers. Finally, Chapter VI concludes the study and makes some policy recommendations.

1.3 Data Sources and Limitations

Data used in the study came from primary and secondary sources: primary data came from interviews of 108 farmers located in all 6 agro-ecological zones and carried out over the months of October and November 1991. In each zone, 3 villages were purposely selected in areas with fertilizer - trials. In each village, 6 farmers who used fertilizer on any of their crops were identified and interviewed.

The survey aimed primarily at eliciting information on the crops farmers grow with fertilizer and the sizes of the fields fertilized. It also sought information on the types and quantities of fertilizer used on each crop and the cost of the input at the farm level. The survey also aimed at uncovering the reasons why farmers may fail to use the recommended quantities of fertilizers.

Most of the secondary data available to the study came from the Ministry of Agriculture, Government of Ghana. It includes information on fertilizer imports, food crop prices at the rural market level, area planted to various crops and estimated outputs.

CHAPTER 2

ANALYTICAL FRAMEWORK OF THE STUDY

2.1 Defining the Agro-Economic Potential of Fertilizers

Conceptually, the agro-economic potential of fertilizers for a specific crop in a given agro-ecological zone is the highest level of returns that can be attained when: (1) the best land and crop management and other agricultural practices known are used, (2) fertilizer and crop markets function properly, and (3) price and other economic policies are consistent with the objectives of overall economic development. The first condition implies that the highest level of crop response to fertilizer use -- referred to as agronomic potential of fertilizers -- is achieved, while the latter conditions suggest that the fertilizer-crop terms of trade are, from social standpoint, favorable to crop production. The agro-economic potential of fertilizers is defined as follows:

$$\pi_{fi} = R_{fi} - T_{fi} \quad (1)$$

where π_{fi} = agro-economic potential or the highest level of returns to fertilizer use in the production of crop, expressed as a net output derived from one Kg of

nutrients,

R_{fi} = agronomic potential or the highest level of crop response to fertilizer use, expressed as the volume of crop output contributed by one kg of fertilizer nutrients,

T_{fi} = fertilizer cost at the farm level under well-functioning crop and fertilizer markets, expressed as the volume of crop output needed to purchase one kg of fertilizer nutrients. It is also referred to as the fertilizer-crop terms of trade.

The agronomic potential of fertilizer use is the marginal output contributed by one kg of fertilizer nutrients. In a more elaborate way, this parameter is given by:

$$R_{fi} = e_{fi}(Q_i/Q_f) \qquad (2)$$

where e_{fi} = elasticity of crop output with respect to fertilizer nutrients,

Q_i = the highest level of crop output produced when fertilizers and the best land and crop management practices are used. This output is expressed in kgs of

crop output,

Q_f = the optimum amount of fertilizer used, expressed in kg of fertilizer nutrients.

While the fertilizer-crop terms of trade is given by:

$$T_{fi} = P_f/P_i \quad (3)$$

where P_i = producer price in local currency per Kg of crop output

P_f = fertilizer price at the farm level expressed in local currency per kg of fertilizer nutrients.

Therefore, the expression (1) becomes:

$$\pi_{fi} = e_{fi}(Q_i/Q_f) - (P_f/P_i) \quad (4)$$

As shown in expression (4), the agro-economic potential of fertilizers is given by the elasticity of crop output with respect to fertilizer nutrients, the average product of fertilizers in the production of the crop, and the fertilizer-crop terms of trade. For simplicity of presentation, the expression (3)can be rewritten as follows:

$$\pi_{fi} = e_{fi}A_{fi} - T_{fi} \quad (5)$$

where: A_{fi} = average product of fertilizer nutrients in the production of the crop, expressed in kgs of crop output per kg of fertilizer nutrients,

T_{fi} = farm-level terms of trade between the fertilizer nutrients and crop, expressed in kgs of crop output (needed to purchase) per kg of fertilizer nutrients.

If it could be assumed that at the research stations the best crop management, fertilizer use, and other agricultural practices are observed by scientists while conducting fertilizer trials, the same cannot be said of the estimate of crop response to fertilizer use derived by scientists. It is difficult to find a production function derived at the research station that provides an estimate of the effective share of output associated with fertilizer input. More often, agronomists tend to provide a crude approximation of the crop response to fertilizer use by contrasting the output from fertilized plots with the output from non-fertilized ones. In doing so, they ignore the interactions between fertilizers and other inputs, and consequently, they over-estimate the contribution of fertilizer input to crop output.

Furthermore, the prevailing market conditions and economic policies cannot be considered as socially sound. Therefore, it is hard to provide a "true" estimate of the agro-economic potential of fertilizers. It should be recalled that, the agro-economic potential of fertilizer use is the highest level of returns to fertilizer use that can be attained when technical and economic conditions are socially

sound. Hence, it is not socially possible to attain this level of returns. What could be computed is not the agro-economic potential "per se", but the estimate of fertilizer returns at the research station. This estimate is a crude approximation of the agro-economic potential of fertilizers. The expression (5) is correctly written as follows:

$$\hat{\pi}_{fi} = \hat{R}_{fi} - \hat{T}_{fi} \qquad (6)$$

where ^ stands for approximation. It is clear from expression (6) that this study focuses on key factors affecting the fertilizer-crop terms of trade. The study of agronomic potential of fertilizer use in Ghana concentrates on biophysical factors as well as on land and crop management practices affecting the crop response to fertilizer use (Henao and Dennis, 1992).

2.2. Determinants of Agro-economic Potential of Fertilizer Use

Crop response to fertilizer use and the fertilizer-crop terms of trade are the two determinants of the agro-economic potential of fertilizer use. These determinants are, in turn, affected by a number of factors. First, the crop response to fertilizer use is a product between the share of the crop output ascribed to fertilizer input and the average product (productivity) of the same input. Therefore, to get a change in crop response to fertilizer use, a change in fertilizer share and productivity of this input must occur. In turn, these changes assume a change in input structure and in the level of technical

efficiency, among other things[2].

Three questions related to crop response to fertilizer use are to be examined. First, has the share of fertilizers in production input structure increased over time as a result of government policies to promote the modernization of smallholder agriculture? Second, has this change led to an increase in the share of crop output associated with fertilizer use? Finally, has the average product of fertilizer (or efficiency of fertilizer use) improved as more resources are allocated to research and extension? These questions are examined by analyzing the trends of the above parameters during the study period. The analysis of this issue is taken up by Henao and Dennis (1992).

Second, the fertilizer-crop terms of trade at the farm level is made up of two variables that need to be examined in detail in order to assess the effects of economic forces on the level of returns to fertilizer use. These variables are the farm-level crop and fertilizer prices. To begin with, let all the crops be divided into importable (e.g. maize), exportable (e.g. cocoa), and nontradable crops (e.g. cassava). Needless to say that in Ghana fertilizers are imported. The producer prices for importable and exportable crops can be expressed as follows:

$$P_m = P_m^w E (1 + t_m) (1 - d_m) \qquad (7)$$

[2]The share of fertilizers in input structure is given by :u=f/V where u is the share of fertilizers, f is the value of fertilizers at a constant price and V is the total value of all the production inputs at a constant price. It should be recalled that technological transformation of agriculture assumes a change in the structure of inputs in favor of fertilizers and other modern inputs, as well as an improvement in technical efficiency as some human and financial resources are shifted towards research and extension.

$$P_x = P_x^w E (1 \pm t_x) (1 - d_x) \quad (8)$$

Where P_m = producer price of importable crop in local currency per kg of importable crop output,

P_x = producer price of exportable crop in local currency per kg of exportable crop output,

P_m^w = world market price of importable crop as (CIF price) in foreign currency per kg of the crop output,

P_x^w = world market price of exportable crop (FOB price) in foreign currency per kg of the crop output,

E = official exchange rate expressed in units of local currency per unit of foreign currency,

t_m = taxes and levies imposed on importable crop as a percentage of world market price,

t_x = taxes and levies (subsidies or bonuses) imposed on exportable crop as a percentage of the world market price,

d_m = cost incurred to transfer the importable crop from the

farm to the world market place (e.g. Tema port). This cost is expressed as a percentage of the price of importable crop after it has been cleared by government $[P_m^w E (1 + t_m)]$,

d_x = cost incurred to transfer the exportable crop from the farm to the world market place (e.g. Tema port). This cost is expressed as a percentage of the price of exportable crop after it has been cleared by government $[P_x^w E (1 \pm t_x)]$.

Let us note that for nontradable crops, the farm (or village) is the appropriate primary market. The price at this market is P_h. As for fertilizer, its price at the farm level can be expressed as follows:

$$P_f = P_f^w E (1 \pm t_f) (1 + d_f) \qquad (9)$$

Where P_f = fertilizer price at the farm level in local currency per kg of fertilizer nutrients,

P_f^w = fertilizer world market price expressed as in foreign currency (CIF price) per kg of fertilizer nutrients,

t_f = taxes and levies (subsidies or bonuses) imposed on fertilizers as a percentage of the world market price,

d_f = cost incurred to transfer fertilizers from the port of entry to the farm level as a percentage of the price after this product has been cleared by government $[P_f^w E (1 \pm t_f)]$.

All the expressions above can be condensed for convenience as follows:

$$P_m = P_m^w E (G_m) (D_m) \tag{10}$$

$$P_x = P_x^w E (G_x) (D_x) \tag{11}$$

$$P_f = P_f^w E (G_f) (D_f) \tag{12}$$

Under this new presentation, G_m, G_x, and G_f are price-distorting policy adjustment factors for importable crop, exportable crop, and fertilizers respectively; while D_m, D_x, and D_f stand for the transfer-cost adjustment factors for the same crops and input, respectively. The first factor takes into account the government price policy distortions. The latter factors reflect both structural and institutional deficiencies associated with the supply, distribution and marketing systems. These deficiencies are translated into high transfer cost of the crops and fertilizers.

Let us note that G_m, G_x, G_f, D_m, D_x, and D_f are defined in the following intervals : $0 < G_m < \infty$, $0 < G_x < \infty$, $0 < G_f < \infty$

$0 < D_m < 1$, $0 < D_x < 1$, $0 < D_f < 1$.

For any practical purpose, Ghana is a small country in the world market. The world market prices for importables and exportables and fertilizers are given. Through appropriate price and price-related policies, government can affect the producer prices of tradable crops and the price of fertilizers at the farm level by changing the magnitude of G_m, G_x, G_f, D_m, D_x, and D_f. In so doing, the farm level terms of trade between fertilizers and tradable crops will also be affected. These terms of trade can be expressed as follows:

$$P_f/P_m = (P_f^w/P_m^w) \ (G_f/G_m) \ (D_f/D_m) \tag{13}$$

$$P_f/P_x = (P_f^w/P_x^w) \ (G_f/G_x) \ (D_f/D_x) \tag{14}$$

It is clear that if $G_f/G_m = 1$ or $G_f/G_x = 1$, this suggests that crop and fertilizer price policies do not affect the terms of trade between these crops and fertilizer input. If $G_f/G_m > 1$ or $G_f/G_x > 1$, this indicates that the prevailing crop and fertilizer price policies have turned the fertilizer-crop terms of trade against crop producers. In this case, other things being the same, the use of fertilizers is constrained. But, if $G_f/G_m < 1$ or $G_f/G_x < 1$, this implies that the prevailing price policies related to both tradable crops and fertilizers have turned the fertilizer-crop terms of trade in favor of crop producers. Here, the use of fertilizers in the production of these crops is promoted.

With respect to the transfer of these tradable crops from the farm to the market place, if D_m or/and D_x is smaller than 1, this indicates

that the transfer system (with all its components) presents serious structural and institutional deficiencies. These deficiencies impede the transfer of the crops from the farm to the markets, and consequently constrain the production of these crops. This is true even if the fertilizer supply and distribution systems face little structural and institutional deficiencies (D_f being close to 1). Because it will still be difficult for the farmers to use more fertilizers in order to produce a high volume of output which will be difficult to sell at a profitable price level.

Now consider that D_m and D_x are close to one, that is the transfer system of the tradable crops is efficient and works smoothly. But consider that fertilizer supply and delivery systems are characterized by serious structural and institutional deficiencies ($D_f > 1$). Despite the fact that the crop marketing system works efficiently, it will still be difficult for the farmer to secure more fertilizers for his crop, because the fertilizer supply and distribution systems are inefficient. Here again, the production of the crops will be constrained.

In both cases, the use of fertilizers is constrained, and so is the production of the tradable crops. The lesson to draw is that, among other things, both the crop and fertilizer distribution and marketing systems have to work efficiently if the use of fertilizers or any other purchased input is to be promoted, and hence crop production. That is D_f/D_m and D_f/D_x should be close to one.

For nontradable crops, it is important to underline that the reference market considered here is the farm or village. These crops are

seldom subject to government price distortions. The price of a nontradable crop at the farm level is P_h. The farm level terms of trade between the fertilizer input and this crop are given by:

$$P_f/P_h = (E/P_h)\ (P_f^w)\ (G_f)\ (D_f) \qquad (15)$$

From this expression, it is clear that the government of Ghana can affect the farm-level terms of trade between fertilizers and nontradable crops by changing the official exchange rate (E), G_f and D_f. A devaluation of the local currency (that is more units of the domestic currency for one unit of foreign exchange) will turn the terms of trade against nontradable crops. This will discourage the use of this input in the production of nontradable crops. A taxation of fertilizers will lead to $G_f > 1$, this will increase the cost of fertilizers in terms of nontradable crop. This tends to limit the use of fertilizers in the production of these crops. If $G_f < 1$, the terms of trade are distorted in favor of nontradable crops through government price policies, e.g. fertilizer subsidy. The use of fertilizers, in this case, tends to be stimulated. If $G_f = 1$, that is no price-policy distortion is introduced in the fertilizer subsector by the government. In this case, the terms of trade are not affected by government price-policies. Here, the use of fertilizers is neither stimulated nor discouraged.

If fertilizer supply and distribution systems are marked by serious structural and institutional deficiencies ($D_f > 1$), the price of fertilizers in terms of the nontradable crop will increase, and hence the use of fertilizers in the production of nontradable crops will

decline. The contrary holds for a well functioning fertilizer supply and distribution system.

It is important to note that conceptually nontradable crops are those crops for which the supply and demand clear in the domestic market, given the prevailing supply and demand conditions. A widespread use of fertilizers and other innovations will lead to a rightward shift in the supply curve of these nontradable crops. If the demand schedule does not shift as well, there will be an excess supply in the domestic market. This excess has to be cleared through export; otherwise a decline in the prices of these nontradable crops will occur restricting the use of fertilizers on these crops. This is a long-term scenario that needs to be kept in mind.

In sum, farmers will use fertilizer input or demand more of it, if the following conditions are met: (1) the returns to fertilizer use are statistically significant; (2) farmers have access to well-functioning crop, fertilizer and other input markets, (3) information, fertilizer, and credit/cash are available and accessible to farmers at the appropriate time and location. The first condition assumes that the crop response at the farm level is high and that fertilizer-crop terms of trade are favorable to crop producers. The foregoing methodological note has mostly focused on these two variables. We should, however, add that this study will also examine other factors that affect the use of fertilizers.

CHAPTER 3

CROPS, AGRO-ECOLOGICAL ZONES, AND FERTILIZER USE

3.1 Main Crops Produced and Description of Different Agro-Ecological Zones

Crops dominate the agricultural economy of Ghana contributing to over 80 percent of the total agricultural output. The food-crops subsector is by far the largest contributor where roots and tubers, namely, cassava, cocoyam, and yams account for 46 percent of the agricultural GDP. Plantain contributes 9 percent and cereals such as maize, rice, sorghum and millet account for another 7 percent. Vegetables and fruits, minor contributors to total agricultural output, account for 3 percent of such production. Cocoa, the principal export crop in Ghana, accounts for about 13 percent of the agricultural GDP.

There are 5 major agro-ecological zones defined on the basis of climate, reflected by the natural vegetation and influenced by soils. These are the Coastal Savanna, the Rain Forest, the Semi-Deciduous Forest, the Transitional zone and the Interior Savanna. The latter is often subdivided into two, namely, the Guinea Savanna and the Sudan Savanna yielding, in effect, 6 agro-ecological zones in all.

The Coastal Savanna is low lying and restricted to a narrow belt along the coast stretching from east of Sekondi-Takoradi right up to the border with Togo. The zone covers about 16,000 km^2 and accounts for about 7% of the total area of Ghana. Rainfall in the zone ranges from 600 mm

to 1150 mm per year with the lowest rainfall in the whole country being experienced in the eastern parts of the zone.

The Coastal Savanna is mostly a zone of grass and scrub. The soils are inherently poor. The most useful of these, agriculturally, are the friable savanna ochrosols around the Volta estuary, and the black Akuse clays in the central parts of the zone. The latter soils are the least cultivated at present because they are heavy and difficult to work with, with the simple traditional tools widely employed in the area. Nonetheless, the black Akuse clays are young soils, fertile and can support the cultivation of rice, cotton and sugarcane. Staples such as maize, cassava and vegetables are widely grown in the zone. The littoral around Anloga in the south-eastern part of the zone is home to a thriving shallot industry.

The Rain Forest covers the extreme south west of Ghana embracing the whole of the Western Region. The Semi-Deciduous Forest which is more extensive, covers parts of Ashanti, Brong Ahafo, Central, Eastern and Volta Regions. The two zones extend over 84,000 km^2, approximately 35% of Ghana. Little of the original forest remains under reserve. Most of the two zones are taken up by farmland and land undergoing rejuvenation under bush fallow agriculture.

The forest belt, as a whole, enjoys the highest rainfall in the country with annual rainfall ranging from 1150 mm in the south-east to over 2000 mm in the extreme south-West. The rains come in two seasons, the major and the minor seasons. The zones are a dissected plateau averaging 130 m above sea level and have an undulating topography. Vegetation is luxuriant, giving the impression of highly fertile soils

underneath. On the contrary, soils in the forest belt are not very fertile, inherently, and are unsuitable for continuous cultivation.

Soils in the Rain Forest zone are generally acidic due to the heavy leaching of nutrients. These soils, nonetheless, support tree crops such as oil palm, rubber, and coconut and a variety of foodcrops (Table 1). Although soils in the zone are not ideal for cocoa, production of the crop has spread in recent years to make the Western Region the foremost producer of cocoa at present. Soils in the Semi-Deciduous zone are among the most important agricultural soils in Ghana. They support most of the country's cocoa crop and are extensively planted to the starchy staples. The two zones produce most of the agricultural and mineral exports, and are by far, the most important from the economic view point.

Situated north of the forest belt is the Transitional zone. It covers parts of Ashanti, Brong-Ahafo, Eastern and Volta Regions. Most parts are between 120 m and 275 m above sea level. The rainfall, which averages 1300 mm per year comes in two seasons. The vegetation is derived savanna. The soils are mostly savanna ochrosols and contain less organic matter than their forest counterparts. The soils are fairly fertile and support a wide variety of crops. Maize, yam and tobacco are important cash crops while staples like cassava and to a lesser extent, plantains, are widely cultivated. Although farming in the zone is largely small-scale and traditional, large scale commercial production is widespread and so is the use of fertilizer in the production of crops.

The Interior (Northern) Savanna, as noted earlier, comprises two

zones, namely the Guinea Savanna and the Sudan Savanna. These two zones together with the adjacent Transitional zone described earlier cover about 152,000 km^2 or approximately 57 percent of the country. The Guinea Savanna is by far the larger of the two northern agro-ecological zones and covers the whole of Northern Region and the Upper West Region. The Sudan Savanna zone is confined to the Upper East Region. The two zones have much in common. There is only one rainy season; the rains normally start in late August or early September and tail off in October. The annual rainfall averages 1100 mm in the Guinea Savanna and 1000 mm in the Sudan Savanna. There is one long dry period in which no crops or pasture grow, except under irrigation.

Vegetation in the Guinea Savanna zone is a mixture of fairly tall grasses and widely spaced fire-resistant trees. Most of the zone is low-lying with a rolling topography. The soils are generally poor. Ground-water lathyritic soils are widespread and are shallow soils, unsuitable for mechanized agriculture. The better soils are found in the flood plains and along river banks. However, the prevalence of river blindness has until very recently rendered many of these agriculturally rich soils unavailable for cultivation. Rice is produced in the valley bottoms, on relatively large scale mechanized farms. Maize production has grown in recent years and the zone promises to become the leading producer of this crop in the near future. Cotton, another important cash crop, is more important to small scale farmers. Millet, sorghum and yam are principal crops in the zone, but groundnuts and vegetables are also widely produced. Livestock production is an important activity in the zone. Over 70 percent of all the cattle, sheep and goats in Ghana are

found in this zone.

3.2 Distribution of Fertilized Area Among Various Crops

The survey of farmers carried out under the present study provides useful information on the crops farmers in Ghana who grow with fertilizers, the areas fertilized, hence the proportion of the total fertilized area falling under individual crops. For all the six agro-ecological zones, as Table 2 indicates, 72.0 percent of the total area fertilized was under cereals, with maize (54.7%) and rice (10.0%) as the leading crops. Oil seeds accounted for 12.2 percent of the total fertilized area, with oil palm (7.10%) as the main crop. Another 11.3 percent of the fertilized area was under vegetables with tomatoes (5.0%) and garden eggs (4.5%) as the principal vegetable crops. Roots, tubers and plantain, which as noted earlier contribute about 55 percent of the agricultural GDP in Ghana, occupied a mere 1.8 percent of the total fertilized area. The rest of the fertilized area was occupied by fruits (1.6%), pulses (0.8%) and other crops, namely cotton and cocoa (0.3%).

The agro-ecological zones differ in the share of the fertilized area planted to the different classes of crops (Table 3 - Table 8). The differences are more marked between the zones in the forest on one hand and zones in the savanna on the other. Cereals are less important as cash crops in the forest zones. Less than a quarter of the fertilized area was allocated to these crops in the forest zones during the survey season. In the savanna zones, over 70 percent of the fertilized crop area was devoted to cereals.

In the Rain Forest zone, as Table 3 shows, 35.6 percent of the

area fertilized was planted to cereals. Swamp rice (20.7%) and maize (14.9%) were the leading cereals in the zone. The cultivation of rice has spread rapidly in recent years and is likely to expand further in the future. This is destined to boost fertilizer use in the zone and with it the share of cereals in the total fertilized area. Oil seed crops are also important cash crops in the zone and benefit from fertilizer inputs. About 31.4 percent of the fertilized area was under such crops. Oil palm is the foremost oil seed crop and accounted for 21.5 percent of the total fertilized area. Coconut (6.6%) and groundnuts (3.3%) are other oil seed crops that benefit from fertilizer in the zone.

In the Semi-Deciduous Forest zone oil palm, an oil seed crop, is the foremost crop to which farmers apply fertilizer. As Table 4 shows, 46.1 percent of the total fertilized area reported was under oil palm. The cultivation of oil palm has expanded in recent years especially its out-grower schemes. Given the active extension support by the oil palm companies, fertilizer use on the crop is likely to increase considerably in the future. Maize, a cereal crop, which received the largest share of the total fertilized area in most zones, accounted for only 21.8 percent of such land in the Semi-Deciduous Forest zone. Vegetable crops such as tomatoes (7.3%) and pepper (4.0%) accounted for 15.3 percent of the total fertilized area in the zone. The share for the starchy staples in the total fertilized area was highest in this zone with 9.2 percent of all the land being planted to such crops. As the Table 4 shows, plantain alone claimed 7.9 percent of all the fertilized land area. The proportion of the total fertilized area planted to fruits (5.3%), pulses

(1.0%) and other crops such as cocoa (1.3%), remained largely negligible.

In the Coastal Savanna zone, maize, the foremost cereal reported in the survey, occupied 75.3 percent of the fertilized area (Table 5). Vegetable crops (7.9%) and fruit crops, namely pineapples (7.9%) were also beneficiaries of the input. Oil palm rather surprisingly, claimed 5.9 percent of the fertilized area and pulses another 4.0 percent of the land. The share of cereals in the total fertilized crop area rose to 79.1 percent in the Transitional zone (Table 6). Maize, the leading cereal, accounted for 70.8 percent and rice 8.3 percent of the total fertilized area. Vegetable crops claimed a further 19.2 percent of the fertilized area, with garden eggs (13.6%) and tomatoes (5.6%) as the main crops. Only about 1.1 percent of the fertilized area was allocated to yam.

The proportion of the total fertilized area planted to cereals is at its peak in the Guinea Savanna zone. As Table 7 shows, cereals occupied 99.1 percent of the crop land receiving fertilizer in the zone. Maize, the principal cash crop in the zone, accounted for 85.0 percent of all the fertilized area. Other cereal crops such as rice (6.6%), guinea corn (4.0%) and millet (3.5%) claimed very little of the fertilized area and so did other crops such as cotton (0.6%) and vegetable crops (0.3%). In the Sudan Savanna, the distribution of the total fertilized area among crops differs from what has been described for the Guinea Savanna. Although 71.0 percent of all the fertilized area reported was under cereals, no single cereal crop dominates the scene in this zone (Table 8). Thus maize (24.1%), rice (21.7%), guinea corn

(17.0%) and millet (8.2%) all claimed substantial proportions of the total fertilized area in the Sudan Savanna. Unlike the Guinea Savanna, other non-cereal crops have greater access to the input in this zone. Thus groundnuts were planted to 19.4 percent of the fertilized area and vegetables, notably tomatoes, occupied 9.6 percent of the total fertilized area.

In sum, the survey indicates that the bulk of fertilized area is concentrated in the Northern part of Ghana where cereals occupy the largest share of the cultivated land area. About 68.8 percent of the fertilized area surveyed was located in the three Northern agro-ecological zones.

3.3 Distribution of Fertilizer Nutrients among Crops

Not only do cereals cover most of the fertilized crop area in Ghana, but they also use the bulk of the fertilizer in terms of the total nutrients supplied. For all agro-ecological zones, as Table 9 shows, cereals accounted for 80.1 percent of the total fertilizer nutrients (NPK) used by respondents in the survey. Other classes of crops receiving significant shares of the total nutrients were vegetable crops (11.1%) and oil seed crops (7.2%). The roots, tubers, fruits, cotton, cocoa and pulses together claimed 1.6 percent of the total nutrients.

The importance of cereals and the non-cereal crops as cash crops is a major determinant of the share of total nutrients going to the different classes of crops in the zones. In the Rain Forest and the Semi-Deciduous Forest zones, where cereals are less important cash crops

relative to non-cereal crops, only 50.6 percent and 17.6 percent of the total nutrients, respectively, went to cereal crops (Tables 10). Vegetable crops (27.3%) and oil seed crops (13.3%) received substantial shares of the total fertilizer nutrients used in the Rain Forest zone. In the Semi-Deciduous Forest zone, oil seeds (57.1%) were the main recipients of the fertilizer nutrients, but the share of vegetables (14.5%) was also significant (Table 11). The roots and tuber crops, which as noted earlier, covered 8.3 percent of the fertilized area in the Rain Forest and 9.2 percent in the Semi-Deciduous Forest received only 4.8 percent and 4.7 percent of the fertilizer nutrients, respectively. Fruits (5.3%) in the Semi-Deciduous Forest and pulses (4.0%) in the Rain Forest received only token shares of the total nutrients.

In all the other agro-ecological zones, the bulk of the nutrients went to cereals (Tables 12-15). The share to cereals rose from 76.3 percent in the Sudan Savanna to 91.3 percent in the Coastal Savanna and soared to 99.2 percent in the Guinea Savanna. Next to cereals are vegetable crops in many of the zones. The share of vegetable crops in the total nutrients in the zones where this is significant, increased from 5.4 percent in the Coastal Savanna to 15.4 percent in the Sudan Savanna and reached 21.7 percent in the Transitional zone. Oil seeds, notably groundnuts, received 7.9 percent of the total nutrients in the Sudan Savanna.

As can be seen from Tables 10-15, the three Northern zones claimed 76.3 percent of the volume of fertilizer nutrients used in Ghana during the 1991 crop season by smallholder farmers. The Guinea Savanna zone

took the lead, followed by Sudan Savanna and Transitional zone. The Southern zones received about 23.7 percent of the quantity of fertilizer nutrients used with Coastal Savanna leading, followed by Semi-Deciduous and High Rain Forest zones.

3.4 Rates of fertilizer nutrient application

Among fertilized crops, cereal and vegetable crops received, in all, the highest rate of fertilizer nutrient application per acre of fertilized land area. The roots and tubers, as a group, had the lowest rate. Looking at individual crops, cotton received 61.0 kg of NPK nutrients per acre of fertilized land area; tomato had 52.5 kg; maize 47.8 kg; rice 42.8 kg; guinea corn 34.8 kg; pepper 33.6 kg; and millet 33.0 kg. Oil palm, garden eggs, other vegetable crops (ginger, onion, okro), and orange received about 30 kg of NPK nutrients per acre of fertilized land area, whereas cocoa had 22.5 kg. Other crops received less than 20 kg of NPK nutrients per acre of fertilized land area during the study crop season (Table 16).

The pattern of fertilizer use per acre of fertilized land area varies across agro-ecological zones. In the High Rainfall zone, beans/cowpea received about 66.0 kg of NPK nutrients followed by okro 45.0 kg, rice 39.5 kg, garden eggs 39.1 kg, maize 35.6 kg, and pepper 32.1 kg. Other crops received less than 20.0 kg of NPK nutrients per acre of fertilized land area (Table 17). In the Semi-Deciduous zone, oil palm led all the other crops with 39.1 kg of NPK nutrients per acre of fertilized land area. It was followed by pepper with 33.7 kg, ginger with 33.5 kg, and tomatoes with 30.4 kg. In this zone, maize, cassava,

and cocoa received about 25.6 kg, 22.5 kg, and 22.5 kg, respectively. In sum, oil palm and vegetable crops received most fertilizer nutrients per acre of fertilized land area in the Semi-Deciduous zone (Table 18).

In the Coastal Savanna zone, maize led all the other crops with about 41.4 kg of NPK nutrients per acre of fertilized land area. It was followed by pepper with 33.0 kg, garden eggs with 22.5 kg and tomatoes with 20.1 kg, while oil palm and pineapple had less than 20.0 kg of NPK nutrients per acre of fertilized land area (Table 19). In the Transitional zone, tomatoes received 56.5 kg of NPK nutrients per acre of fertilized land area, maize 34.8 kg, garden eggs 29.8 kg, pepper 22.5 kg, rice 20.0 kg, and yam 5.0 kg. In all, vegetable crops as a group received more fertilizer nutrients per acre of fertilized land area than any other crop group in the Transitional zone during the 1991 crop season (Table 20).

In the Guinea Savanna zone, maize crop received 65.0 kg of NPK nutrients per acre of fertilized land area, cotton 61.0 kg, rice 41.4 kg, tomatoes 33.0 kg, millet 23.8 kg, and guinea corn 20.4 kg. Cereals, as a group, were leading, followed by cotton, and then vegetable crops (tomatoes) (Table 21). In the Sudan Savanna zone, vegetable crops as a group had the highest rate of fertilizer nutrient application per acre of fertilized land area with tomatoes leading the group. They were followed by cereals with rice in the lead. Groundnuts received about 17.8 kg of fertilizer nutrients per acre of fertilized land area (Table 22).

The comparison of the rates of fertilizer nutrient application per acre of fertilized land area with the recommended rates for selected

crops indicates that a gap exists (Table 23). In the High Rainfall, Semi-Deciduous and Coastal Savanna zones, maize on continuously cropped land area received only 58.4, 42.0, 67.9 percent of the recommended rates, respectively. In Transitional, Guinea Savanna and Sudan Savanna zones, the amount of fertilizer nutrients applied to maize per acre of fertilized land area was about 66.2, 106.6, and 82.6 percent of the recommended amount respectively. For upland rice, this cereal received 31.2, 64.7, and 83.1 percent of the recommended dosage in the Transitional, Guinea Savanna, and Sudan Savanna zones respectively. As for sorghum, this cereal received about 42.5 percent of the recommended rate of fertilizer nutrient application in Guinea Savanna zone and 79.8 percent in the Sudan Savanna zone during the 1991 main crop season.

If the crop response to fertilizer use is to be enhanced this gap needs to be narrowed. The survey reveals that about 31.2 percent of the farmers who did not use the recommended rate of fertilizer affirmed that the lack of sufficient funds was the main reason that prevented them from using the recommended amount of fertilizer. Another reason, offered by about 27.3 percent of the farmers that did not use the recommended quantity of fertilizers, was that this input is too expensive. The third main reason, advocated by 18.2 percent of the farmers, was the lack of extension service and labor (Table 24). Therefore, the need for effective credit and extension services cannot be overemphasized.

3.5 Types of fertilizers used by agro-ecological zone in Ghana

About 15 types of fertilizers were used during the 1990 crop

season in Ghana (Table 25)[3]. This appears too large a number of fertilizer types to be introduced in the smallholder agriculture for a number of reasons. First, as the entire volume of fertilizers used in Ghana is imported, a large number of fertilizer types makes the quality control difficult and expensive. These different fertilizer types are bound to come from many sources making it difficult to draw a coherent import strategy which would enable the country to take advantage of bulk import from a few sources in terms of cost, product quality, and delivery.

Second, it is not evident whether all these fertilizer types are appropriate for Ghanaian soils and weather conditions. Third, it is hard to get the smallholder farmer to use the proper quantity of fertilizer nutrients if fertilizer types are too many or keep changing from one season to another. The distribution of different fertilizer types by agro-ecological zone indicates that 3 fertilizer types were used in High Rainfall zone during the surveyed season, 6 in Semi-Deciduous zone, 5 in Coastal Savanna, 5 in Transitional zone, 6 in Guinea Savanna zone, and 8 in Sudan Savanna zone. The types of fertilizers used in all the zones, but the High-Rainfall zone, are too numerous for farmers to correctly master the different use practices related to each type, particularly with respect to dosage.

A further observation of the survey data indicates that no more than 3 types of fertilizers were substantially used in any agro-ecological zone during the 1991 crop season. In the High Rainfall zone,

[3]The survey did not provide adequate information about the composition of 4 minor types of fertilizers used. The trade names of these fertilizers are PAPR, glofol, superfox, and sampi.

two types of fertilizers were most used with NPK (15-15-15) claiming 79.0 percent of total fertilizer nutrients and ammonium sulphate (21-0-0) accounting for 19.6 percent. In Semi-Deciduous zone, NPK (15-15-15) followed by potassium chloride (0-0-43) and ammonium sulphate (21-0-0) were most used. In Coastal Savanna, three different types were most used with NPK (15-15-15) taking the lead followed by NPK (20-20-0) and ammonium sulphate (21-0-0). In Transitional zone, NPK (20-20-0), ammonium sulphate, and NPK (15-15-15) were the main fertilizer types used. In Guinea Savanna, NPK (15-15-15), ammonium sulphate (21-0-0), and NPK (20-20-0) were most used. In Sudan Savanna, NPK (15-15-15), ammonium sulphate (21-0-0) and urea (46-0-0) were the most used fertilizer types during the crop season.

For Ghana as a whole, 3 fertilizer types were most used during the crop season, with NPK (15-15-15) accounting for 46.8 percent of the total nutrients, ammonium sulphate (21-0-0) for 22.1 percent, and NPK (20-20-0) for 14.8 percent. These 3 fertilizer types contributed 83.7 percent of nutrients used during the 1991 crop season. Other fertilizer types provided 16.3 percent of nutrients with urea (46-0-0) accounting for 7.3 percent. On the basis of available research findings, efforts should be made to select among these different fertilizer types those that are both ecologically and economically sound. The number of fertilizer types to be retained for each agro-ecological zone should be probably limited to no more than 2 types in order to help efficient introduction of this input in the smallholder agriculture. In the subsequent sections of this study, an attempt will be made to classify these fertilizer types on the basis of their cost per kg of nutrients at

the village level across different agro-ecological zones of Ghana.

TABLE 1: AREA PLANTED TO AND OUTPUTS OF MAJOR FOODCROPS IN AGRO-ECOLOGICAL ZONES, GHANA, 1987.

Agro-ecological zones	MAIZE Area (%)	MAIZE Output (%)	RICE Area (%)	RICE Output (%)	SORGHUM Area (%)	SORGHUM Output (%)	MILLET Area (%)	MILLET Output (%)
1. Rain Forest	51492 (9.39)	43500 (7.28)	5450 (7.58)	5747 (7.10)	.	.	.	.
2. Semi Deciduous Forest	224155 (40.88)	281649 (47.12)	9421 (13.10)	9382 (11.60)	.	.	.	.
3. Transitional Zone	81249 (14.81)	117361 (19.63)	11405 (15.85)	13349 (16.51)	1552 (0.57)	1164 (0.56)	2488 (1.06)	1493 (0.86)
4. Coastal Savanna	26679 (4.86)	26892 (4.50)	658 (0.91)	630 (0.78)	.	.	.	.
5. Guinea Savanna	160761 (29.30)	125298 (21.00)	38000 (52.82)	44341 (54.84)	203550 (74.93)	163173 (78.75)	162528 (69.16)	132413 (76.50)
Sudan Savanna	4000 (0.73)	3000 (0.50)	7000 (9.73)	7401 (9.15)	66544 (24.50)	42600 (20.60)	70000 (29.78)	39200 (22.64)
ALL ZONE	**548336**	**597700**	**71934**	**80805**	**271464**	**205937**	**235016**	**173106**

Source: Ministry of Agriculture, PPMED, Accra, GHANA.

TABLE 1 - Continued

Agro-ecological zones	CASSAVA Area (%)	CASSAVA Output (%)	YAM Area (%)	YAM Output (%)	COCOYAM Area (%)	COCOYAM Output (%)	PLANTAIN Area (%)	PLANTAIN Output (%)
1. Rain Forest	46067 (11.83)	318785 (11.69)	11700 (5.73)	43056 (3.63)	30000 (5.10)	166200 (16.43)	21812 (12.84)	125201 (11.62)
2. Semi Deciduous Forest	228300 (58.62)	154977 (56.82)	42691 (20.91)	244497 (20.62)	136212 (68.55)	686308 (67.83)	155933 (68.25)	732531 (67.97)
3. Transitional Zone	74903 (19.23)	601837 (22.08)	52028 (25.49)	372643 (31.40)	32394 (16.31)	159254 (15.74)	32122 (18.91)	219937 (20.41)
4. Coastal Savanna	25185 (6.47)	143196 (5.25)	.	.	.	.	.	.
5. Guinea Savanna	15000 (3.85)	112950 (4.14)	97713 (47.87)	525361 (44.31)	.	.	.	.
Sudan Savanna	.	.	.	.	.	.	.	.
ALL ZONE	**389455**	**2726746**	**204132**	**1185557**	**198805**	**1011762**	**169867**	**1077669**

Source: Ministry of Agriculture, PPMED, Accra, GHANA. ( ) % of zonal total.

TABLE 1 - Continued

Agro-ecological zones	GROUNDNUT Area (%)	GROUNDNUT Output (%)	BEANS Area (%)	BEANS Output (%)	TOMATOES Area (%)	TOMATOES Output (%)	VEGETABLES Area (%)	VEGETABLES Output (%)
1. Rain Forest	-	-	33 (0.02)	2 (0.01)	355 (179)	1695 (1.86)	5508 (6.49)	14870 (4.90)
2. Semi Deciduous Forest	3431 (2.28)	5526 (2.90)	3447 (2.15)	275 (1.57)	11044 (55.78)	49535 (54.40)	34382 (40.50)	11284 (37.16)
3. Transitional Zone	8278 (5.50)	13569 (7.10)	4739 (2.96)	418 (2.39)	2644 (13.35)	12335 (13.54)	23306 (27.50)	88116 (29.02)
4. Coastal Savanna	1431 (0.95)	1066 (0.55)	1666 (1.04)	122 (0.70)	5755 (29.07)	27485 (30.19)	11231 (13.20)	33995 (11.12)
5. Guinea Savanna	9000 (59.81)	116301 (61.00)	70000 (43.78)	7100 (40.53)	n.a	n.a	10399 (12.30)	53995 (17.78)
Sudan Savanna	47323 (31.45)	54210 (28.43)	80000 (50.03)	9800 (54.80)	n.a	n.a	8	40
ALL ZONE	**150463**	**190672**	**159886**	**17617**	**19798**	**91050**	**84834**	**303637**

Source: Ministry of Agriculture, PPMED, Accra, GHANA. ( ) % of zonal total.

Table 2: Distribution of fertilized area among various crops in Ghana as a whole, 1991 main cropping season

Crops	Area Fertilized (Acres)	% of area fertilized in zone
Cereals	**547.9**	**72.0**
maize	416.0	54.7
millet	20.0	2.6
guinea corn	36.0	4.7
rice	75.9	10.0
Roots & Tubers	**14.0**	**1.8**
cassava	4.0	0.5
yam	2.0	0.3
plantain	8.0	1.1
Oil seed crops	**93.0**	**12.2**
oil palm	54.0	7.1
coconut	4.0	0.5
groundnuts	35.0	4.6
Vegetable crops	**85.8**	**11.4**
garden eggs	34.0	4.5
tomatoes	38.3	5.0
pepper	9.5	1.3
other vegetables*	4.0	0.6
Fruit crops	**12.0**	**1.6**
oranges	4.0	0.5
pineapple	8.0	1.1
Pulses	**5.8**	**0.8**
beans/cowpeas		
Other crops	**2.0**	**0.2**
cotton	1.0	0.1
cocoa	1.0	0.1
All the crops	**760.5**	**100.0**

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project Survey, Data Computer printout, IFPRI, Washington, 1992.

*Other vegetables include ginger, onion, and okro.

Table 3: Distribution of fertilized area among various crops in the High Rainfall Zone, 1991 main cropping season

Crops	Area Fertilized (Acres)	% of area fertilized in zone
Cereals	**21.5**	**35.6**
maize	9.0	14.9
rice	12.5	20.7
Roots & Tubers	**5.0**	**8.3**
cassava	3.0	5.0
plantain	2.0	3.3
Oil Seed Crops	**19.0**	**31.4**
oil palm	13.0	21.5
coconut	4.0	6.6
groundnuts	2.0	3.3
Vegetable Crops	**14.0**	**23.1**
garden eggs	5.5	9.1
tomatoes	4.0	6.6
pepper	4.0	6.6
okro	0.5	0.8
Pulses	**1.0**	**1.6**
beans/cowpeas	1.0	1.6
All the crops	**60.5**	**100.0**

Source : IFDC/IFPRI/ISSER Fertilizer Policy Project: Survey Data, Computer Printout IFPRI, Washington, 1992.

Table 4: Distribution of fertilized area among various crops in the Semi-Deciduous Zone, 1991 main cropping season

Crops	Area Fertilized (Acres)	% of area fertilized in zone
Cereals	**16.5**	**21.8**
maize	16.5	21.8
Roots & Tubers	**7.0**	**9.2**
cassava	1.0	1.3
plantain	6.0	7.9
Oil Seed Crops	**35.0**	**46.2**
oil palm	35.0	46.2
Vegetable Crops	**11.5**	**15.3**
tomatoes	5.5	7.3
pepper	3.0	4.0
other vegetables	3.0	4.0
Fruit Crops	**4.0**	**5.3**
oranges	4.0	5.3
Pulses	**0.8**	**1.0**
beans/cowpeas	0.8	1.0
Other Crops	**1.0**	**1.3**
cocoa	1.0	1.3
All the crops	**75.8**	**100.0**

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project : Survey Data, Computer Printout IFPRI, Washington, 1992.

Table 5: Distribution of fertilized area among various crops in the Coastal Savanna Zone, 1991 main cropping season

Crops	Area Fertilized (Acres)	% of area fertilized in zone
Cereals	**75.0**	**74.3**
maize	75.0	74.3
Oil seed crops	**6.0**	**5.9**
oil palm	6.0	5.9
Vegetable crops	**8.0**	**7.9**
garden eggs	4.0	4.0
tomatoes	3.0	3.0
pepper	1.0	1.0
Fruit crops	**8.0**	**7.9**
pineapple	8.0	7.9
Pulses	**4.0**	**4.0**
beans/cowpeas	4.0	4.0
All the crops	**101.0**	**100.0**

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project: Survey Data, Computer Printout IFPRI, Washington, 1992.

Table 6: Distribution of fertilized area among various crops in the Transitional Zone, 1991 main cropping season

Crops	Area Fertilized (Acres)	% of area fertilized in zone
Cereals	**142.5**	**79.1**
maize	127.5	70.8
rice	15.0	8.3
Roots & Tubers	**2.0**	**1.1**
yams	2.0	1.1
Vegetable crops	**35.5**	**19.7**
garden eggs	24.5	13.6
tomatoes	10.0	5.6
pepper	1.0	0.6
All the crops	**180.0**	**100.0**

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project: Survey Data, Computer Printout IFPRI, Washington, 1992.

Table 7: Distribution of fertilized area among various crops in the Guinea Savanna Zone, 1991 main cropping season

Crops	Area Fertilized (Areas)	% of area fertilized in zone
Cereals	**171.5**	**99.1**
maize	147.0	85.0
millet	6.0	3.5
Guinea Corn	7.0	4.1
rice	11.5	6.7
Vegetable crops	**0.5**	**0.3**
tomatoes	0.5	0.3
Other Crops	**1.0**	**0.6**
cotton	1.0	0.6
All the crops	**173.0**	**100.0**

Source : IFDC/IFPRI/ISSER Fertilizer Policy Project : Survey Data, Computer Printout IFPRI, Washington, 1992.

Table 8: Distribution of fertilized area among various crops in the Sudan Savanna Zone, 1991 main cropping season

Crops	Area Fertilized (Areas)	% of area fertilized in zone
Cereals	**120.9**	**71.0**
maize	41.0	24.1
millet	14.0	8.2
Guinea Corn	29.0	17.0
rice	36.9	21.7
Oil seed crops	**33.0**	**19.4**
groundnuts	33.0	19.4
Vegetable crops	**16.3**	**9.6**
tomatoes	15.3	9.0
pepper	0.5	0.3
onion	0.5	0.3
All the crops	**170.2**	**100.0**

Source : IFDC/IFPRI/ISSER Fertilizer Policy Project: Survey Data, Computer Printout IFPRI, Washington, 1992.

Table 9: Distribution of fertilizer Nutrients Among Various Crops in Ghana, 1991 main crop season

Crops	Quantity of fertilizers (kgs)		
	fertilizer (kgs)	nutrients (kgs)	%
Cereals	**71112.0**	**25059.6**	**80.1**
maize	57052.0	19894.8	
millet	1650.0	659.8	
guinea corn	3475.0	1253.3	
rice	8935.0	3251.9	
Roots & Tubers	**475.0**	**201.0**	**0.6**
cassava	150.0	67.5	
yam	25.0	10.0	
plantain	300.0	123.5	
Oil seed crops	**6400.0**	**2236.0**	**7.2**
oil palm	4300.0	1570.0	
coconut	100.0	45.0	
groundnuts	2000.0	621.0	
Vegetable crops	**8940.0**	**3485.9**	**11.1**
garden eggs	2825.0	1034.8	
tomatoes	5315.0	2009.3	
pepper	800.0	318.8	
other vegetable crops*	325.0	123.0	
Fruit crops	**450.0**	**164.5**	**0.5**
oranges	350.0	121.5	
pineapple	100.0	43.0	
Pulses	**251.0**	**66.0**	**0.2**
beans/cowpeas	251.0	66.0	
Other crops	**250.0**	**83.5**	**0.3**
cotton	200.0	61.0	
cocoa	50.0	22.5	
Ghana	**88203.0**	**31296.5**	**100.0**

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

*Other vegetable crops include ginger, onion and okro.

Table 10: Distribution of Fertilizer Nutrients among Various crops in the High Rainfall Zone of Ghana, 1991 main crop season

Crops	Quantity of fertilizers (kgs)	Quantity of nutrients (kgs)				
		N	P_2O_5	K_2O	NPK	%
Cereals	**2350.0**	**402.6**	**206.3**	**206.3**	**815.2**	**50.4**
maize	925.0	178.3	71.3	71.3	320.9	
rice	1425.0	224.3	135.0	135.0	494.3	
Roots & Tubers	**200.0**	**33.0**	**22.5**	**22.5**	**78.0**	**4.8**
cassava	100.0	15.0	15.0	15.0	45.0	
plantain	100.0	18.0	7.5	7.5	33.0	
Oil seed crops	**500.0**	**78.0**	**67.5**	**67.5**	**213.0**	**13.2**
oil palm	300.0	45.0	45.0	45.0	135.0	
coconut	100.0	15.0	15.0	15.0	45.0	
groundnuts	100.0	18.0	7.5	7.5	33.0	
Vegetable crops	**1200.0**	**204.1**	**120.0**	**120.0**	**444.1**	**27.5**
garden eggs	625.0	110.3	52.5	52.5	215.3	
tomatoes	200.0	33.0	22.5	22.5	78.0	
pepper	325.0	53.3	37.5	37.5	128.3	
okro	50.0	7.5	7.5	7.5	22.5	
Pulses	**200.0**	**36.0**	**15.0**	**15.0**	**66.0**	**4.1**
beans/cowpea	200.0	36.0	15.0	15.0	66.0	
Zone	**4450.0**	**753.7**	**431.3**	**431.3**	**1616.2**	**100.0**

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

Table 11: **Distribution of Fertilizer Nutrients among Various crops in the Semi-Deciduous Zone of Ghana, 1991 main crop season**

Crops	Quantity of fertilizers (kgs)	Quantity of nutrients (kgs)				
		N	P_2O_5	K_2O	NPK	%
Cereals	**1302.0**	**174.0**	**161.3**	**86.3**	**421.6**	**17.6**
maize	1302.0	174.0	161.3	86.3	421.6	
Roots & Tubers	**250.0**	**53.0**	**30.0**	**30.0**	**113.0**	**4.7**
cassava	50.0	7.5	7.5	7.5	22.5	
plantain	200.0	45.5	22.5	22.5	90.5	
Oil seed crops	**3850.0**	**465.0**	**102.5**	**800.0**	**1367.5**	**57.1**
oil palm	3850.0	465.0	102.5	800.0	1367.5	
Vegetable crops	**875.0**	**187.6**	**140.0**	**82.5**	**347.1**	**14.5**
tomatoes	400.0	63.0	52.5	52.5	168.0	
pepper	250.0	33.0	45.5	22.5	101.0	
ginger	50.0	5.3	11.5	0.0	16.8	
onion	75.0	12.8	7.5	7.5	27.8	
okro	100.0	10.5	23.0	0.0	33.5	
Fruit crops	**350.0**	**61.5**	**30.0**	**30.0**	**121.5**	**5.1**
oranges	350.0	61.5	30.0	30.0	121.5	
Pulses	**51.0**	**n.a**	**n.a**	**n.a**	**n.a**	**n.a**
beans/cowpea	51.0	n.a	n.a	n.a	n.a	
Other crops	**50.0**	**7.5**	**7.5**	**7.5**	**22.5**	**0.9**
cocoa	50.0	7.5	7.5	7.5	22.5	
Zone	**6728.0**	**885.6**	**471.3**	**1036.3**	**2393.2**	**100.0**

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

[1]No information on the composition of fertilizers used on beans and cowpeas was available.

Table 12: Distribution of Fertilizer Nutrients among Various crops in the Coastal Savanna Zone of Ghana, 1991 main crop season

Crops	Quantity of fertilizers (kgs)	Quantity of nutrients (kgs)				
		N	P_2O_5	K_2O	NPK	%
Cereals	**8750.0**	**1821.5**	**890.0**	**390.0**	**3101.5**	**91.3**
maize	8750.0	1821.5	890.0	390.0	3101.5	
Oil seed crops	**150.0**	**22.5**	**22.5**	**22.5**	**67.5**	**2.0**
oil palm	150.0	22.5	22.5	22.5	67.5	
Vegetable crops	**550.0**	**73.3**	**57.5**	**57.5**	**183.3**	**5.4**
garden eggs	200.0	30.0	30.0	30.0	90.0	
tomatoes	150.0	25.3	20.0	15.0	60.3	
pepper	100.0	18.0	7.5	7.5	33.0	
Fruit crops	**100.0**	**33.0**	**10.0**	**0.0**	**43.0**	**1.3**
pineapple	100.0	33.0	10.0	0.0	43.0	
Zone	**9550.0**	**1950.3**	**980.0**	**465.0**	**3395.6**	**100.0**

Source : IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

[1]The survey did not provide information on the nutrient content of fertilizers used on pulses (beans and cowpeas).

Table 13: Distribution of Fertilizer Nutrients among Various crops in the Transitional Savanna Zone of Ghana, 1991 main crop season

Crops	Quantity of fertilizers (kgs)	Quantity of nutrients (kgs)				
		N	P_2O_5	K_2O	NPK	%
Cereals	**14000.0**	**3197.5**	**1295.0**	**245.0**	**4737.5**	**78.1**
maize	12750.0	2937.0	1255.0	245.0	4437.0	
rice	1250.0	260.5	40.0	0.0	300.5	
Roots & Tubers	**25.0**	**5.0**	**5.0**	**n.a**	**10.0**	**0.2**
yam	25.0	5.0	5.0	n.a	10.0	
Vegetable crops	**3540.0**	**719.0**	**403.5**	**194.5**	**1317.0**	**21.7**
garden eggs	2000.0	409.5	217.5	102.5	729.5	
tomatoes	1490.0	302.0	178.5	84.5	565.0	
pepper	50.0	7.5	7.5	7.5	22.5	
Zone	**17565.0**	**3921.5**	**1703.5**	**439.5**	**6064.5**	**100.0**

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

Table 14: Distribution of Fertilizer Nutrients among Various crops in the Guinea Savanna Zone of Ghana, 1991 main crop season

Crops	Quantity of fertilizers (kgs)	Quantity of nutrients (kgs)				
		N	P_2O_5	K_2O	NPK	%
Cereals	**30550.0**	**5871.0**	**2472.0**	**1967.0**	**10310.0**	**99.2**
maize	28100.0	5379.0	2232.0	1937.0	9548.0	
millet	500.0	103.0	40.0	0.0	143.0	
guinea corn	500.0	103.0	40.0	0.0	143.0	
rice	1450.0	286.0	160.0	30.0	476.0	
Vegetable crops	**50.0**	**9.0**	**3.8**	**3.8**	**16.6**	**0.2**
tomatoes	50.0	9.0	3.8	3.8	16.5	
Other crops	**200.0**	**41.0**	**20.0**	**0.0**	**61.0**	**0.6**
cotton	200.0	41.0	20.0	0.0	61.0	
Zone	**30800.0**	**5921.0**	**2495.8**	**1970.8**	**10387.6**	**100.0**

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

Table 15: Distribution of Fertilizer Nutrients among Various crops in the Sudan Savanna Zone of Ghana, 1991 main crop season

Crops	Quantity of fertilizers (kgs)	Quantity of nutrients (kgs)				
		N	P_2O_5	K_2O	NPK	%
Cereals	**14160.0**	**3005.2**	**1421.6**	**1246.6**	**5673.4**	**76.3**
maize	5225.0	1241.0	457.5	367.5	2066.0	
millet	1150.0	286.8	138.8	91.3	516.9	
guinea corn	2975.0	544.3	296.3	268.8	1109.4	
rice	4810.0	933.1	529.0	519.0	1981.1	
Oil seed crops	**1900.0**	**315.0**	**145.5**	**127.5**	**588.0**	**7.9**
groundnuts	1900.0	315.0	145.5	127.5	588.0	
Vegetables crops	**3150.0**	**558.0**	**310.0**	**310.0**	**1178.0**	**15.8**
tomatoes	3025.0	531.5	295.0	295.0	1121.5	
pepper	75.0	19.0	7.5	7.5	34.0	
onion	50.0	7.5	7.5	7.5	22.5	
Zone	**19210.0**	**3878.2**	**1877.1**	**1684.1**	**7439.4**	**100.0**

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

Table 16: Rate of Fertilizer Application by Crop for Ghana as a Whole, 1991 main crop season

Crops	Area Fertilized (acres)	Quantity of fertilizer nutrients (kgs)	Fertilizer nutrients in kgs per acre of fertilized area
Cereals	**547.9**	**25058.7**	---
maize	416.0	19894.8	47.8
millet	20.0	659.8	33.0
guinea corn	36.0	1252.2	34.8
rice	75.9	3251.9	42.8
Roots & Tubers	**14.0**	**201.0**	---
cassava	4.0	67.5	16.8
yam	2.0	10.0	5.0
plantain	8.0	123.5	15.4
Oil seed crops	**93.0**	**2236.0**	---
oil palm	54.0	1570.0	29.1
coconut	4.0	45.0	11.3
groundnuts	35.0	621.0	17.7
Vegetable crops	**81.8**	**3385.9**	---
garden eggs	34.0	1034.8	30.4
tomatoes	38.3	2009.3	52.5
pepper	9.5	318.8	33.6
other vegetable crops*	4.0	123.0	30.8
Fruit crops	**12.0**	**164.5**	---
oranges	4.0	121.5	30.4
pineapple	8.0	43.0	5.4
Pulses	**5.8**	**66.0**	---
beans/cowpeas	5.8	66.0	11.5
Other crops	**2.0**	**83.5**	---
cotton	1.0	61.0	61.0
cocoa	1.0	22.5	22.5
Ghana	**760.5**	**31295.6**	---

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

*Other vegetable crops include ginger, onion and okro.

Table 17: Rate of Fertilizer application by crop in High Rainfall Zone of Ghana, 1991 main crop season

Crops	Area Fertilized (acres)	Quantity of fertilizer nutrients (kgs)	Fertilizer nutrients in kgs per acre of fertilized area
Cereals	**21.5**	**815.2**	---
maize	9.0	320.9	35.6
rice	12.5	494.3	39.5
Roots & Tubers	**5.0**	**78.0**	---
cassava	3.0	45.0	15.0
plantain	2.0	33.0	16.5
Oil seed crops	**19.0**	**213.0**	---
oil palm	13.0	135.0	10.4
coconut	4.0	45.0	11.3
groundnuts	2.0	33.0	16.5
Vegetable crops	**14.0**	**444.1**	---
garden eggs	5.5	215.3	39.1
tomatoes	4.0	78.0	19.5
pepper	4.0	128.3	32.1
okro	0.5	22.5	45.0
Pulses	**1.0**	**60.0**	---
beans/cowpea	1.0	60.0	66.0
Zone	**60.5**	**1616.2**	---

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

Table 18: Rate of Fertilizer Application by crop in Semi-Deciduous Zone, Ghana, 1991 main crop season

Crops	Area Fertilized (acres)	Quantity of fertilizer nutrients (kgs)	Fertilizer nutrients in kgs per acre of fertilized area
Cereals	**16.5**	**421.6**	---
maize	16.5	421.6	25.6
Roots & Tubers	**7.0**	**112.0**	---
cassava	1.0	22.5	22.5
plantain	6.0	90.5	15.1
Oil seed crops	**35.0**	**1367.5**	**39.1**
oil palm	35.0	1367.5	39.1
Vegetable crops	**11.5**	**347.1**	---
tomatoes	5.5	168.0	30.6
pepper	3.0	101.0	33.7
ginger	0.5	16.8	33.5
onion	1.0	27.8	27.6
okro	1.5	33.5	22.3
Fruit crops	**4.0**	**121.5**	---
oranges	4.0	121.5	30.4
Pulses	**0.8**	**n.a**	**n.a**
beans/cowpea	0.8	n.a	n.a
Other crops	**1.0**	**22.5**	---
cocoa	1.0	22.5	22.5
Zone	**75.0**	**2393.2**	---

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

[1]No information on the composition of fertilizers used on beans and cowpeas was available.

Table 19: Rate of Fertilizer Application by crop in Coastal Savanna Zone of Ghana, 1991 main crop season

Crops	Area Fertilized (acres)	Quantity of fertilizer nutrients (kgs)	Fertilizer nutrients in kgs per acre of fertilized area
Cereals	**75.0**	**3101.5**	---
maize	75.0	3101.5	41.4
Oil seed crops	**6.0**	**67.5**	---
oil palm	6.0	67.5	11.3
Vegetable crops	**8.0**	**183.3**	---
garden eggs	4.0	90.0	22.5
tomatoes	3.0	60.3	20.1
pepper	1.0	33.0	33.0
Fruit crops	**8.0**	**43.0**	**5.4**
pineapple	8.0	43.0	5.4
Zone	**97.0**	**3395.3**	---

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

Table 20: **Rate of Fertilizer Application by crop in the Transitional Zone of Ghana, 1991 main crop season**

Crops	Area Fertilized (acres)	Quantity of fertilizer nutrients (kgs)	Fertilizer nutrients in kgs per acre of fertilized area
Cereals	**142.5**	**4737.5**	---
maize	127.5	4437.0	34.8
rice	15.0	300.5	20.0
Roots & Tubers	**2.0**	**10.0**	---
yam	2.0	10.0	5.0
Vegetable crops	**35.5**	**1317.0**	---
garden eggs	24.5	729.5	29.8
tomatoes	10.0	565.0	56.5
pepper	1.0	22.5	22.5
Zone	**180.0**	**6064.5**	---

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

Table 21: Rate of Fertilizer Application by crop in the Guinea Savanna Zone of Ghana, 1991 main crop season

Crops	Area Fertilized (acres)	Quantity of fertilizer nutrients (kgs)	Fertilizer nutrients in kgs per acre of fertilized area
Cereals	**171.5**	**10310.0**	---
maize	147.0	9548.0	65.0
millet	6.0	143.0	23.8
guinea corn	7.0	143.0	20.4
rice	11.5	476.0	41.4
Vegetable crops	**0.5**	**16.6**	---
tomatoes	0.5	16.6	33.0
Other crops	**1.0**	**61.0**	---
cotton	1.0	61.0	61.0
Zone	**173.0**	**10387.6**	---

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

Table 22: Rate of Fertilizer Application by crop in the Sudan Savanna Zone of Ghana, 1991 main crop season

Crops	Area Fertilized (acres)	Quantity of fertilizer nutrients (kgs)	Fertilizer nutrients in kgs per acre of fertilized area
Cereals	**120.9**	**5673.2**	---
maize	41.0	2066.0	50.4
millet	14.0	516.8	36.9
guinea corn	29.0	1109.3	38.3
rice	36.9	1381.1	53.7
Oil seed crops	**33.0**	**588.0**	---
groundnuts	33.0	588.0	17.8
Vegetables crops	**16.3**	**1178.0**	---
tomatoes	15.3	1121.5	73.5
pepper	0.5	34.0	68.0
onion	0.5	22.5	45.0
Zone	**170.2**	**7439.2**	---

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI Washington DC 1992.

Table 23: Gaps between Recommended and Effectively used Rates of Fertilizer Nutrients on Selected Crop in Ghana, 1991 Main Crop Season*.

Crop/rates of fertilizer nutrients application	Agro-ecological zones					
	High Rainfall	Semi Deciduous	Coastal Savanna	Transitional zone	Guinea Savanna	Sudan Savanna
MAIZE						
- Recommended rate in kg of nutrients per acre	61.0	61.0	61.0	61.0	61.0	61.0
- Rate used	35.6	25.6	41.4	34.8	65.0	50.4
- Rate used as percentage of recommended rate	58.4	42.0	67.9	66.2	106.6	82.6
UPLAND RICE						
- Recommended rate in kg of nutrients per acre	-	-	-	64.0	64.0	64.0
- Rate used	-	-	-	20.0	41.4	53.7
- Rate used as percentage of recommended rate	-	-	-	31.2	64.7	83.1
SORGHUM						
- Recommended rate in kg of nutrients per acre	-	-	-	-	48.0	48.0
- Rate used	-	-	-	-	20.4	38.3
- Rate used as percentage of recommended rate	-	-	-	-	42.5	79.8

Sources: IFDC/IFPRI/ISSER Survey data - Computer Printout, IFPRI, Washington, 1992. Owusu B. (1990), Fertilizer Requirements for major crops in Ghana. Manuscript, University of Ghana, Legon.

*It is assumed that the cultivated land area is continuously cropped.

Table 24 : Reasons for not using the recommended quantity of fertilizers per acre of fertilized area.

Reason	Numbers of farmers	%	Bank
Limited funds	7	31.2	1
Fertilizer is too expensive	6	27.3	2
Lack of Extension Service and Labor	4	18.2	3
Crop does not need all the quantity recommended	2	9.1	4
Use farm manure/fertilizer not effective	2	9.1	4
Not aware of any recommendation	1	4.5	5
Shortage of fertilizer in the district	1	4.5	5
Difficult to contact Extension officer	1	4.5	5
SURVEY ZONES	**22**	**100.0**	---

Source: IFDC/IFPRI/ISSER Survey data - Computer Printout, Legon, Ghana, 1992.

Table 25: Types and quantity of fertilizers used by agro-ecological zone in Ghana, 1991 main crop season.

Fertilizer Types		High Rainfall		Semi-Deciduous		Coastal Savanna		Transitional Zone		Guinea Savanna		Sudan Savanna		Ghana	
Name	Composi-tion	Kg of Nutrients	%	Kg of Nutrients	%	Kg of Nutrients	%	Kg of Nutrients	%	Kg of Nutrients	%	Kg of Nutrients	%	Kg of Nutrients	%
NPK	15-15-15	1276.8	79.0	1268.4	53.0	1229.2	36.2	1085.5	17.9	5245.7	50.5	4813.3	64.7	14918.9	47.7
A/S	21- 0- 0	316.8	19.6	414.0	17.3	685.9	20.2	1388.8	22.9	3085.1	29.7	1093.6	14.7	6984.2	22.3
NPK	20-20- 0	0.0	0.0	0.0	0.0	1042.4	30.7	2334.8	38.5	1256.9	12.1	0.0	0.0	4634.1	14.8
UREA	46- 0- 0	22.6	1.4	28.7	1.2	254 7	7.5	715.6	11.8	353.2	3.4	952.2	12.8	2327.0	7.4
NPK	25-15- 5	0.0	0.0	0.0	0.0	183.4	5.4	539.7	8.9	135.0	1.3	260.4	3.5	1118.5	3.6
NPK	17-17-17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	311.6	3.0	0.0	0.0	311.6	1.0
KCL	0- 0-60	0.0	0.0	540.9	22.6	0.0	0.0	0.0	0.0	0.0	0.0	208.3	2.8	749.2	2.4
NPK	23-15- 5	0.0	0.0	126.8	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	126.8	0.4
TSP	0-46- 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.0	0.9	67.0	0.2
NPK	22-20- 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.5	0.3	22.5	0.1
SSP	0-18- 0	0.0	0.0	14.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	22.3	0.3	36.7	0.1
ALL TYPES	-	1616.2	100.0	2393.2	100.0	3395.6	100.0	6064.5	100.0	10387.6	100.0	7439.4	100.0	31296.6	100.0

Note that TSP = Triple Superphosphate, SSP = Single Superphosphate, A/S = Ammonium Sulphate, KCl = Potassium Chloride.

Source: IFDC/IFPRI/ISSER Fertilizer Policy Project - Survey Data, Computer Printout, IFPRI, Washington, DC, 1992.

CHAPTER 4

ANALYSIS OF AGRO-ECONOMIC POTENTIAL OF FERTILIZER USE

As specified in the methodological note in Chapter II, the agro-economic potential of fertilizer use could be approximated to the highest returns that can be derived from fertilizer use given the prevailing technical and economic conditions. These returns to fertilizer use are a function of the crop response to fertilizer use and the farm-level fertilizer-crop price ratio. In this regard, this chapter presents the crop responses to fertilizer use in different agro-ecological zones of Ghana, examines the farm level fertilizer-crop terms of trade that prevailed during the study season and estimates the level of agro-economic potential of fertilizer use.

4.1 - Level of Crop Response to Fertilizer Use

Statistical analysis applied to agronomic data collected in various agro-ecological zones indicates that most crops produced in Ghana are significantly responsive to fertilizer use (Henao and Dennis 1992). (Table 26) summarizes some of the main findings related to crop responses to fertilizer use in Ghana. Maize response to fertilizer use in different administrative regions of the country is found to vary from 6.9 kg of maize-grains per kg of NPK nutrients in Brong-Ahafo to 18.6 kg in the Volta region. Rice response to fertilizer use in Volta and

Northern regions is also found to vary between 13.5 kg of paddy-rice per kg of NPK nutrients to 18.5 kg. Cassava crop has the highest response to fertilizer use of about 120.8 kg of fresh cassava tubers per kg of NPK nutrients. Sorghum, soya bean, cowpea and cotton significantly respond, but in decreasing order, to fertilizer use in Ghana.

It should be noted that these crop responses are derived from agronomic experiments and are likely to be much higher than the levels that are achieved by farmers on their own-fields. If farmer's response level is assumed to be 75 percent of what researchers achieve, most crops, except cotton and cowpea, will still display an acceptable level of response to fertilizer use. But, if the response level on farmer's fields is 50 percent of what can be achieved at the research station, then the use of fertilizer would likely be limited, other things being the same, to a few crops in a few administrative regions. These crops would be cassava, maize, rice, sorghum and soybean. Therefore, the need for an efficient extension service that can help to narrow the gap between crop response level at the farm and research station cannot be overemphasized.

4.2 - Fertilizer-Crop Terms of Trade

Fertilizer price policy has been a subject of serious debate among policy makers, donors, and economists alike. This debate has focused on the issue of fertilizer subsidy. This study does not attempt to examine

this issue that has been at the center of many studies on pricing policy[4]. Some of these studies see some merit in fertilizer subsidy, while others consider this pricing policy an inefficient way of promoting the use of fertilizer and other improved farm inputs. The latter view appears to prevail among donors and international financial institutions.

The phasing out and the total elimination of fertilizer subsidy has been adopted as part of policy reforms under structural adjustment programs. The structural adjustment program also includes measures to develop competitive market systems that will promote increased efficiency and decreased cost in the distribution and the marketing of farm products and inputs. Bangladesh was able to synchronize the fertilizer subsidy removal programs with the development of such a competitive market system. This effort led to decreased fertilizer price and increased fertilizer use[5].

As a part of common knowledge, it is well established that the development of a competitive market system for both inputs and products is one of the key conditions to getting any economic activity moving. Providing subsidies as a way of alleviating the effects of market distortions cannot be considered as an efficient and sustainable solution, particularly for developing economies. The case of Senegal is

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[4]Mellor, J., and Ahmed. (eds) 1988 Agricultural Price Policy for Developing Countries. Published for the International Food Policy Research Institute by the John Hopkins University Press, Baltimore, U.S.A.

[5]Bumb, B., 1991. The policy environment and fertilizer sector development: an overview. Manuscript. Training Workshop on Policy Issues Affecting Fertilizer Sector Development and Sustainable Agriculture, September 9-20, 1991. International Fertilizer Development Center (IFDC), Muscle Shoals, Alabama, USA.

a good example. Despite a long history of fertilizer use, the removal of fertilizer subsidy resulted in a staggering drop in fertilizer use (Bumb 1991). The long-term solution to promoting the use of fertilizer and other inputs resides in improving the product and input markets, other services, infrastructures, and institutions.

In this regard, this section of the study presents the farm-level fertilizer-crop terms and examines, in addition the above, other actions that could be taken to reduce the cost of fertilizer use (expressed in terms of crop output needed to purchase one kg of fertilizer nutrients). Table 27 shows the terms of trade between fertilizer nutrients and selected crops at the village level across different agro-ecological zones of Ghana during the 1991 crop season. The cost of fertilizer nutrients varies from about 1.5 kg of maize per kg of nutrients to 3.9 kg. This fertilizer cost appears to increase as we move from South to North. This is explained by the fact that the nominal price of maize at the farm level declines as we move to the North, while the nominal price of fertilizers increases (see annex 2). The Southern regions have a comparative advantage over the Northern zones, inland area of the country.

The differences in prices therefore, can be partly attributed to transport and distribution costs. With respect to rice, the cost of fertilizer nutrients in terms of rice output varies from about one kg of rice per kg of fertilizer nutrients to about 1.8 kg. The nominal price of rice does not exhibit a large degree of variability across regions relative to that of maize. This suggests that rice producing and consuming centers are well dispersed across the country. For maize, the

producing centers appear to be located in the Northern part as well as in the Southern part of the country. While the maize consuming centers are primarily located in the Southern part of the country. The location of producing and consuming centers has some implications for geographical distribution of benefits and costs related to any development program or project.

As for sorghum, the farm-level terms of trade between fertilizer and this crop varies from 1.6 kg of sorghum per kg of fertilizer nutrients to 2.9 kg. In the North, the cost of fertilizer in terms of sorghum output is overall lower than in terms of maize output. In other words, one needs a larger quantity of maize than sorghum in order to purchase one kg of fertilizer nutrients. This is due to the fact that the farm-level price of sorghum is higher than that of maize. Major sorghum producing centers and consuming areas are located in the North. As a result, sorghum producers in the North reap a rent while their maize counterparts do not enjoy the same benefit, as most maize consuming centers are located in the South.

One action that could be taken in order to reduce the cost of fertilizer use is to select among many the fertilizer types currently used in Ghana, those that are ecologically sound and cost-effective. Tables 28 and 29 show that during the 1991 crop season, NPK nutrients came from both compound and single fertilizers. Three NPK fertilizer types with at least 45 percent of NPK nutrients, referred to as high grade fertilizers, were used. Three other NPK fertilizer types, with less than 45 percent of NPK nutrients and referred to as low grade fertilizers, were also recorded during the survey.

The NPK fertilizer with 15 percent of N, 15 percent of P_2O_5, and 15 percent of K_2O was found to be the least expensive with ¢201 per kg of nutrients. Taking NPK (15-15-15) as a number, Table 28 shows that NPK (17-17-17) is about 2.0 percent more expensive than the number, NPK (20-20-0) is about 10.9 percent more expensive, while NPK (22-20-0) is about 25.4 percent more expensive. This analysis appears to suggest that NPK (15-15-15) and NPK (17-17-17) should be two NPK compounds to promote as the main source of N, P_2O_5, and K_2O. In order to maintain the required balance among NPK nutrients, Table 29 suggests that the single fertilizer types to be used should be the triple superphosphate (TSP), potassium chloride (KCl), and urea. Ammonium sulphate (A/S) and single superphosphate (SSP) are relatively too expensive to be promoted. As can be seen, a proper selection of fertilizer types will greatly reduce the cost of fertilizer nutrients at the farm level. This will result in increased returns which, in turn, will stimulate the use of this input among smallholder farmers.

Another important aspect that has a bearing on the fertilizer-crop terms of trade is the timing of the sale of the farm produce by farmers. In Ghana, the government's intervention in food market has been very limited. The Ghana Food Distribution Corporation (GFDC) handled less than 6 percent of the maize marketable surplus during the 1985/88 period. The bulk of maize marketable surplus has been handled by private distributors and traders[6]. Therefore, if most of the sale of farm

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[6]Okyere, A.W. 1990. Guaranteed Minimum Price for Maize: An Assessment of its effectiveness for Future Policy Formulation - Research Report No. 1, Ghana Medium-Term Agricultural Development Program. Ministry of Agriculture, Accra, Ghana.

produce is carried out during or just after harvest, the producer price is likely to be lower than the annual average producer price considered in the analysis. If this is the case, then the terms of trade between fertilizer and crop of concern will move against crop producers. In other words, the cost of fertilizer use incurred by farmers will be high, hence reducing the benefit farmers derive from this input. In all, the fall in crop price during harvest adversely affects farm income. Consequently, appropriate steps must be taken to encourage farmers to store non-perishable products and to time the sale of these and other commodities in such a way that they can derive a better price. A systematic analysis of the agricultural commodity markets is needed to provide detailed information that would help policy makers initiate relevant policy measures to help stabilize producer prices and address other crucial issues related to domestic food and agricultural markets.

Other factors affecting the terms of trade between fertilizer and crops are the exchange rate, duties and levies, and the domestic marketing costs. Since uniform exchange rate policy was applied to both imports and exports, it is clear, as shown in the methodological note, that exchange rate fluctuations did not affect the terms of trade between tradable commodities: e.g. fertilizers and maize, fertilizers and rice or, fertilizers and cotton. In addition, these fluctuations do not significantly affect the terms of trade between tradables and nontradables that are substitutes. For nontradables that are not close substitutes, the change in exchange rate affects the terms of trade between fertilizers and these commodities. Since all the food crops in Ghana are substitutes where they are mostly eaten, a change in the price

of a tradable food crop (maize or rice) resulting from exchange rate fluctuations, will lead to a change in the price of a nontradable food crop (sorghum) such that the terms of trade between fertilizer and the nontradable crop remain unaffected[7]. However, a change in the exchange rate will affect the use of fertilizers during the crop season if farmers use cash to purchase this input or if the amount of credit allocated to the same input does not expand accordingly. This points to the need for a well developed rural credit market that could serve to safeguard against this and other shocks.

The Government of Ghana does not tax the import of fertilizers, but taxes imports of agricultural products. For example, the import of maize, rice, sorghum, attracts 25 percent tax, while the imports of cotton and palm oil are taxed at the rate of 10 and 20 percent respectively[8]. These duties help reduce the price of fertilizers relative to crops. The marketing costs constitute the last group of costs that affect both fertilizer and crop prices. Since domestic fertilizer market is still in its development phase, it could be assumed that structural and institutional inefficiencies abound relative to crop markets that have a long history in the country. Therefore, fertilizer marketing costs are likely to be higher than those for crops. These differential marketing costs will tend to increase the price of fertilizers relative to crops.

In sum, it is the combination of import and export duties imposed

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[7]Tshibaka, Tshikala, B., 1986. The effects of trade and exchange rate policies on agriculture in Zaire. Research Report 56 Washington D.C. International Food Policy Research Institute.

[8]Ghana, (1991) - CEPS Headquarters, Accra.

on agricultural commodities, the domestic fertilizer and crop marketing costs, and the fertilizer and crop world market prices that determine the observed terms of trade between fertilizers and crops in Ghana. Since Ghana is a price taker in the world market, the most critical cost item to examine, in an effort to improve the terms of trade in favor of crop producers, is the marketing costs.

4.3 - Level of Agro-Economic Potential of Fertilizer Use in Ghana

As specified in the analytical framework summarized in chapter II, the agro-economic potential of fertilizer use could be approximated to the level of fertilizer returns achieved at the research station. Table 30 summarizes the estimates of fertilizer returns in the production of maize, rice, and sorghum at the research station. The application of fertilizers to these cereals provide substantive returns.

A comparison of different administrative regions indicates that the returns to fertilizer use in production of maize are much higher in the Volta region. This region is followed, in decreasing order, by the Ashanti, East, Central, and Brong Ahafo regions. The southern portion of the Volta Region is in the Coastal Savanna zone, and the Ashanti Region is in the Semi-Deciduous zone as well as in the Transitional zone. East, Central and Brong Ahafo Regions are respectively in Semi-Deciduous, Coastal Savanna, and Transitional zones. More specifically, every kg of maize spent on fertilizer in Ohawu village located in the southern part of the Volta Region generates about 7.3 kg of maize output. This value/cost ratio is only 1.9 kg of maize in Techiman village in Brong

Ahafo Region. Using a value/cost ratio of 2 as a cut-off point, fertilizers can be used in all the reported villages, except Techiman.

With respect to rice, the data suggests that the use of fertilizers in rice production in the Volta region (Ohawu village) and the Northern region (Nyankpala and Bole villages) is very profitable. The value/cost ratio is about 12.0 in Bole, 11.5 in Ohawu, and 9.0 in Nyankpala. With regard to sorghum, the use of fertilizers on this crop provides a good value/cost ratio in Brong-Ahafo Region.

In all, the use of fertilizers on maize, rice and sorghum is significantly profitable in different agro-ecological zones of Ghana where these crops are generally grown. Since the crop responses to fertilizer use and the fertilizer-crop terms of trade are the key determinants of the level of agro-economic potential of fertilizer use, efforts have to be initiated to increase the crop responses to fertilizer use at the farm level through improved research and extension. Similarly, efforts must be also deployed to improve the fertilizer, crop, and credit markets and other related services in order to reduce the unit cost of fertilizer use and to dampen the effects of various shocks on the use of fertilizer and other inputs.

Table 26: Crop Responses to Fertilizer Use in Ghana

Crop	Administrative Region	Fertilizer Nutrients Kg/Ha				Crop Yield without Fertilizer KG/HA	Increase in Crop Yield due to Fertilizers KG/HA	Crop Response KG of Output per KG of NPK Nutrients
		N	P_2O_5	K_2O	Total			
Maize	Eastern	100	90	45	235	1564.0	2257.0	9.6
	Central	100	90	30	220	1598.0	2029.0	9.2
	Volta	90	50	30	170	1014.0	3160.0	18.6
	Ashanti	120	50	30	200	1395.0	2531.0	12.7
	Brong Ahafo	110	60	20	190	1072.0	1318.0	6.9
Cotton	Central	80	60	20	160	495.0	485.8	3.0
	Volta	80	60	10	150	643.0	988.4	6.6
	Ashanti	100	50	10	160	846.0	557.0	3.5
	Brong Ahafo	150	50	10	210	731.0	810.0	3.9
Cassava	Volta	90	10	20	120	7564.0	14492.6	120.8
Groundnut	Volta	20	140	45	205	397.0	1081.5	5.3
Rice Irrigated	Volta	120	40	40	200	976.0	2707.6	13.5
	Northern	80	30	40	150	876.0	2780.9	18.5
Non-irrigated	Northern	150	40	30	220	815.0	3549.0	16.1
Cowpea	Central	60	40	20	120	236.0	740.4	6.2
	Volta	50	70	20	140	291.0	1014.5	7.3
	Ashanti	80	50	10	140	428.0	705.5	5.0
Soyabean	Ashanti	10	60	10	80	1048.0	770.9	9.6
Sorgham	Brong Ahafo	40	60	20	120	942.0	1334.6	11.2

Source: Taken from Henao and Dennis (1992). Agronomic Potential of Fertilizer Use in Ghana, IFDC/IFPRI/ISSER, Fertilizer Policy Study - Muscles Shoals, Alabama, USA.

Table 27 : Village-Level Fertilizer-Crop Terms of Trade, Ghana 1991.

AGRO-ECOLOGICAL ZONE	ADMINISTRATIVE REGION	VILLAGES	FERTILIZER-MAIZE PRICE RATIO (KG OF MAIZE/KG OF NUTRIENTS)	FERTILIZER-RICE PRICE RATIO (KG OF RICE/KG OF NUTRIENTS)	FERTILIZER-SORGHUM PRICE RATIO (KG OF SORGHUM/KG OF NUTRIENTS)
HIGH RAINFALL	WEST	Aiyinase	1.51	0.99	n.a.
	WEST	Daboase	1.45	n.a.	n.a.
	WEST	Kobina Anno-Krom	1.45	n.a.	n.a.
SEMI-DECIDUOUS FOREST	ASHANTI	Adjamasu	2.00	1.00	1.77
	ASHANTI	Boamang	2.35	1.15	1.69
	EAST	Kade	1.84	0.98	n.a.
COASTAL SAVANNA	G/ACCRA	Amasaman	2.30	1.29	1.57
	CENTRAL	Ojibi	2.07	1.28	n.a.
	VOLTA	Ohawu	2.56	1.18	n.a.
TRANSITIONAL ZONE	B/AHAFO	Techiman	3.59	1.41	2.49
	B/AHAFO	Atebubu	2.45	1.36	2.83
	ASHANTI	Ejura	3.14	1.31	2.57
GUINEA SAVANNA	NORTH	Damango	3.60	n.a.	2.54
	NORTH	Nyankpala	3.06	1.80	2.79
	NORTH	Bole	3.85	1.35	2.92
SUDAN SAVANNA	U/EAST	Manga	2.40	1.31	2.40
	U/EAST	Vea	2.68	1.14	2.39
	U/EAST	Tono	2.57	1.33	2.05

Sources: Computed from IFDC/IFPRI/ISSER, Survey data computer printout, IFPRI, Washington, 1992 and from Ghana Ministry of Agriculture, Agriculture Price Data, Accra, 1991

Note: n.a. means Not Available.

Table 28: Average Village Level Prices of Nutrients from Compound Fertilizers in Ghana, 1991 main crop season.

Types of Compound fertilizers			Average village Level price		Price of nutrients expressed in percentage of the price of the least expensive type	Rank starting with the least Expensive type
Name	Composition % $N-P_2O_5-K_2O$	Nutrient Content in percent	Cedis per kg of fertilizer	Cedis per kg of nutrients	%	
NPK	15-15-15	45	90	201	100.0	1
NPK	17-17-17	51	105	205	102.0	2
NPK	20-20- 0	40	89	223	110.9	3
NPK	25-15- 5	45	102	227	112.9	4
NPK	23-15- 5	43	108	251	124.9	5
NPK	22-20- 0	42	106	252	125.4	6

Source: IFDC/IFPRI/ISSER Survey data - Computer Printout, IFPRI, Washington, 1992.

Table 29 : Average Village Level Prices of Nutrients from Single Fertilizers in Ghana, 1991 main crop season

Types of Single fertilizers			Average village level price		Price of nutrients expressed as percentage of the price of the least expensive type	Rank starting with the least Expensive type
Name	Composition % $N-P_2O_5-K_2O$	Nutrient Content in percent	Cedis per kg of fertilizer	Cedis per kg of nutrients	%	
TSP	0 -46- 0	46	66	143	100.0	1
KCl	0 - 0-60	60	89	148	103.5	2
Urea	46- 0- 0	46	102	221	154.5	3
A/S	21- 0- 0	21	76	360	251.7	4
SSP	0 -18- 0	18	85	472	330.1	5

Source: IFDC/IFPRI/ISSER Survey data - Computer Printout, IFPRI, Washington, 1992.

Table 30: Agro-Economic Potential of Fertilizer Use - Returns to Fertilizer Use on Selected Crops at the Research Station, Ghana, 1991.

CROP	AGRO-ECOLOGICAL ZONE	ADMINISTRATIVE REGION	VILLAGES	Response fertilizer (kg output/ kg of nutrients)	Cost of fertilizer (kg of output/ kg of nutrients)	Returns to fertilizer use (kg of output/kg of nutrients)	Value Cost Ratio
MAIZE	SEMI-DECIDUOUS	ASHANTI	Adjamasu	12.65	2.00	10.65	6.33
		ASHANTI	Boamang	12.65	2.35	10.30	5.38
		EAST	Kade	9.60	1.84	7.76	5.22
	COASTAL SAVANNA	CENTRAL	Ojibi	9.22	2.07	7.15	4.45
		VOLTA	Ohawu	18.59	2.56	16.03	7.26
	TRANSITIONAL ZONE	B/AHAFO	Techiman	6.94	3.59	3.35	1.93
		B/AHAFO	Atebubu	6.94	2.45	4.49	2.83
		ASHANTI	Ejura	12.65	3.14	9.51	4.03
RICE	COASTAL SAVANNA	VOLTA	Ohawu	13.54	1.18	12.36	11.47
	GUINEA SAVANNA	NORTH	Nyankpala	16.13	1.80	14.33	8.96
		NORTH	Bole	16.13	1.35	14.78	11.95
SORGHUM	TRANSITIONAL ZONE	B/AHAFO	Techiman	11.21	2.49	8.72	4.50
		B/AHAFO	Atedubu	11.21	2.83	8.38	3.96

Source: Computed from data taken from tables

Note: Value-Cost ratio is computed as the ratio of response to fertilizer use over the cost of fertilizers.

CHAPTER 5

OTHER DETERMINANTS OF FERTILIZER USE

Crop response to fertilizer use and fertilizer-crop terms of trade are not the only factors that affect the use of fertilizers at the farm level. Other factors also affect the use of this input. This chapter examines some of these factors.

5.1 Market Orientation of Production

An important determinant of fertilizer use especially among small-scale farmers is the orientation of production. Fertilizer is a purchased input and is used mostly on crops produced for market. The use of this input on subsistence-oriented crops is quite limited.

Evidence of the above comes from the survey carried out under this study and described earlier. In the Guinea Savanna Zone, maize, which is a cash crop in the zone, occupied about 85.0 percent of the total fertilized area. Millet and guinea corn, which are major staples, were planted to only 3.5 percent and 4.0 percent, respectively. of the fertilized area. In the Rain Forest and the Semi-Deciduous Forest zones where roots, tubers and plantain are the major staples, less than 10 percent of the area receiving fertilizer went to such crops. On the whole, the survey clearly showed that crops which farmers fertilized most were those destined for sale, namely, cereals in all agro-

ecological zones, oil seed crops, notably oil palm, and vegetables in the Rain Forest and Semi-Deciduous Forest zones, vegetables and oil seeds such as groundnut in the Sudan Savanna and the Transitional zones. This suggests that fertilizer use in Ghana will expand with the increased commercialization of farming.

The production of many of the crops currently cultivated in the various agro-ecological zones is already oriented to the market to varying extent. This came out clearly in a recent study which examined the market orientation of production on small scale farms in three agro-ecological zones in Southern Ghana[9]. It found that all the farmers sold some produce regularly. It also found that whereas a few crops, such as cocoa and coffee, were produced wholly for sale, many foodcrops were produced largely to feed the farm households but substantial portions were sold regularly.

At Anloga, in the Coastal Savanna Zone, the crops produced by most farmers were shallot (95.8%) and vegetables (85.9%). These are cash crops and the proportion of the farmers selling part of the crop was 100 percent for shallots and 82.0 percent for vegetables. Cassava and maize are subsistence crops and were produced by only 25.4 percent and 18.3 percent of the farmers respectively. Even here, 66.7 percent of those producing cassava and 7.7 percent of those producing maize sold part of the crop.

At Ejura, in the Transitional Zone, maize is a major cash crop. It is also a staple for many small scale farm households. About 87.5

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[9]Atsu, S. Y., (1990) The Organization and Management of Agricultural Services to Small Farmers in Africa: The case of Ghana, Report prepared for the FAO, Legon, Ghana.

percent of the farmers in the study area produced maize; 98.6 percent of the producers sold part of the crop and 1.4 percent sold all the maize produced. Other crops produced by significant proportions of the farmers were groundnut (55.0%), cassava (40.0%), plantain (36.2%), yam 35.0%) and cocoyam (30.0%). A few households did not sell any of the crops; the proportion of producers selling part of the crop rose from 87.5 percent for cassava to 97.7 percent for groundnut and reached 100 percent for yam. Crops produced by only small proportions of the respondents included cowpea (8.8%), cocoa (3.8%), beans (3.8%), vegetables (3.5%), rice (2.5%) and sorghum (1.2%). All the cocoa produced was sold. All producers of these minor crops sold part of the output. The exception was cowpea where 71.4 percent of the producers sold part of the crop and 28.6 percent sold all the crop produced.

The range of crops was equally impressive at Wassa, located in the Rain Forest zone. Cocoa, the principal crop in the study area, was produced by all respondents; they sold all of the output. Crops cultivated widely are maize and cassava (74.1%), vegetables (46.3%) and cocoyam (37.3%). All these crops were produced partly for sale and partly for the subsistence needs of the farm households. The proportion of the producers selling part of the output was high and ranged from 80.0 percent for vegetables to 100 percent for maize and cassava.

Other crops reported by respondents at Wassa included palm fruits (16.7%), yam (11.1%), rice (9.3%) and fruits (3.7%). Even these less widely cultivated crops found their way to the market. The proportion of the farmers selling part of these crops ranged from 77.8 percent for palm fruits to 100 percent for rice, yam and fruits.

5.2 Access to Crop Markets

A major factor influencing the decision to use fertilizer, a yield-increasing input, is the ability of the producer to market his product satisfactorily. Farmers in many part of Ghana experience considerable difficulty in the marketing of produce; the only exception perhaps, are those who produce cocoa, coffee and cotton. The first two crops are marketed through the COCOBOD which provides most, if not all, the marketing services needed by the producer. Cotton is sold largely to Ghana Cotton Company and to other buyers who have recently come into the market.

Many farmers are dissatisfied with the conditions under which they market their produce. Those in the survey complained of low prices they received for their produce; they also complained of a narrow range of buyers for their commodities, delays in buying the produce and the absence of storage facilities for farm produce in the villages (Atsu, 1990). As Table 31 shows, of the 205 farmers surveyed only 43.4 percent were satisfied with the existing conditions. Satisfaction was low at Wassa (13.0%) and Ejura (16.3%) and high at Anloga (97.2%). The need for improvements in the conditions under which farmers market their produce as expressed by the farmers themselves was thus very high at Ejura (100.0%) and Wassa (96.3%) and low at Anloga (36.6%). The more important suggestions were those which called for higher prices for farm produce (even where prices are market determined), a wider range of buyers for produce and a greater respect on the part of buyers for the produce-buying calendar. Farmers also called for improved facilities for storage and for transporting farm produce (Table 32).

5.3 Access to Crop Marketing Services

Small-scale farmers in the Ejura area, like those in many other areas in Ghana, have little or no access to the services needed at the farm end of the crop marketing process. Important service functions, including the evacuation of produce from the fields to the village, processing, preservation, storage and grading of farm produce, are not performed by any organization. Admittedly small-scale farmers can be taught how to handle some of these functions effectively. It may be argued however, that some of the functions are best handled on an organized basis.

The service missed most by the farmer is perhaps the prompt evacuation of produce. A problem exists because of the fairly long distances between the fields and the villages, and the absence of access roads to the fields. Headloading or headporterage is invariably the only means of conveying the harvest from the fields. This has far-reaching implications for land use and the national effort to increase food output. It restricts cultivation to land parcels which are within a walking distance of the villages. The more productive parcels may not be cultivated at all because of their poor accessibility or where such fields are cultivated, production is relatively less intensive and often excludes the more important staples because of their bulk.

Crop drying is perhaps the nearest to an organized marketing service encountered at Ejura. This service is organized by the GFDC to enable it to dry its stock of maize purchased from producers. The local farmer has no direct access to the service. Since he cannot have his wet maize dried for a fee, he is denied the opportunity to preserve and hold

his produce over time in anticipation of higher prices. It is tempting to ask why farmers at Ejura cannot be taught how to dry their maize properly. The fact is harvesting of the main season maize crop in the area coincides with the onset of the minor rains. This makes sundrying of the crop difficult.

Small farmers have limited access to organized services at the market-end of the process. The small farmer at Ejura, for instance, experiences difficulties and discriminations in selling his maize to the GFDC, which incidentally is the preferred trading partner. Often he is denied the prompt attention given to the larger maize producers in the sale transactions at the buying depots. Sometimes, he finds it expedient to route his produce through the larger producers. Occasionally the small producer is obliged to sell his crop to the middleman who, in turn, sells to the Corporation. Since the price received from the middleman is considerably lower than that offered by the Corporation, the farmer is denied the advantages inherent in the guaranteed prices of the Corporation.

5.4 Access to Information Pertaining to Fertilizer Use

The total quantity of fertilizer used in Ghana each year remains limited also because only a few crops receive fertilizer. As already mentioned, farmers in Ghana do not apply fertilizer to important staples such as roots, tubers and plantain or to cocoa and other tree crops, largely because they lack information pertaining to fertilizer use on these crops. Very little fertilizer research is done on these crops. Government policy of concentrating the limited imports of fertilizer on

promoting the production of cereals and legumes, has also contributed to the restricted interest in and use of the input on these crops.

The research-extension linkages, which have made possible the development of appropriate technological packages for maize, rice and legumes, notably cowpeas, are missing in the case of most other crops. The development of appropriate technological packages under the Ghana Grains Development Project well illustrates the types of collaboration needed. The Project involves three local institutions, namely the Crops Research Institute (CRI), the Grains and Legumes Development Board (GLDB) and the Ministry of Agriculture (MOA). The last two institutions provide extension staff for the project. The Project features the combination of on-station research with an extensive program of on-farm experimentation throughout the country, with small-scale farmers as the target group. The technological package involved, comprised of improved maize variety, row planting and fertilizer, has proved economically appropriate to small farmer production (having yielded a marginal rate of returns of at least 100% over the farmers' practices, under normal rainfall conditions[10]).

Information pertaining to fertilizer use may exist, as in the case of maize, but some farmers may not have access to it because of poor extension service. Many small-scale farmers in Ghana continue to produce maize without fertilizer even though technological packages for maize exist for different areas in the country. The fact is many farmers are not in contact with the extension agents and therefore do not benefit

[10] Tripp et al (1987) Changing Maize Production Practices of Small-Scale Farmers in the Brong-Ahafo Region, Ghana, Ghana Grains Development, Accra.

from the technological information being disseminated. In the study involving small-scale farmers in 3 agro-ecological zones (Atsu, 1990) only 78 of the 205 farmers (38%) reported contact with the extension agent. The proportion in contact with the extension agent rose from 15 percent at Anloga (Coastal Savanna) to 45 percent at Ejura (Transitional Zone) to reach 57 percent at Wassa (Rain Forest). Of those reporting contact in the aggregate sample, 48 percent claimed to have learned new farm practices; 37 of the number learned about fertilizer use and 33 actually adopted the practice. Thus only 18 percent of all farmers in the study learned of fertilizer use through extension contact and 16 percent adopted the practice. Others learned of fertilizer, use not through extension contact, but from other farmers.

Farmers with easy access to agricultural extension service, and are therefore likely to gain information pertaining to fertilizer use, include those exposed to extension services which are commodity-based (Grains Development Project) or area-based (VORADEP, URADEP). Farmers who cultivate cocoa and commercial crops such as cotton, tobacco and oil palm, also have reasonably easy access to extension service; these crops come under parastatals and private concerns which organize their own extension services. Also, increasing numbers of small-scale farmers in many parts of Ghana are gaining access to extension services through their involvement with Sassakawa Global 2000, a non-governmental organization which organizes the distribution of farm inputs, including fertilizers and improved seeds to small-scale farmers. Many farmers in Ghana, however, do not have easy access to technical information including information on fertilizer use.

5.5 - Availability and Access to Credit

Another important service most farmers need in order to purchase inputs, to hire labor, and to smooth the consumption during the lean period is the credit institution. The survey conducted in all the agro-ecological zones of Ghana reveals that among 108 farmers contacted, 63,9 percent of them used credit to purchase fertilizers. Other farmers used their own cash. The source of credit farmers did use the most, was the informal market. This market served 35.2 percent of the surveyed farmers, whereas the formal market served only 28.7 percent of the study farmers (Table 33). In the informal market, most farmers used relatives as a source of credit with about 50.0 percent of farmers served among those who used informal market. Traders were the next important informal source of credit with about 28.9 percent of the farmers. They were followed by friends who helped 21.1 percent of the farmers. No farmers used money lenders as a source of loan (Table 34).

With respect to formal source of credit, the Sassakawa Global 2000 provided credit to 42.9 percent of farmers that used formal credit market during the crop season. This foundation was followed by the Agricultural Development Bank (ADB) that served about 19.4 percent of the farmers. Social Security Bank (SSB) provided credit to 12.9 percent, and IFDC-Africa Soil Fertility Restoration Project served about 9.7 percent of the farmers that used the formal credit market. Other institutions served about 16.1 percent of the farmers (Table 35).

The large number of farmers using credit points needs to develop credit market in the rural area. This is one of the necessary conditions for promoting a widespread use of fertilizer and other improved inputs.

The available survey data, summarized in Table 24, confirms this observation.

Table 31: Distribution of Farmers According to Satisfaction with Existing Conditions for Marketing Farm Produce and the Need for Improvements

Study Area	View			
	Receiving needed Services		Services need Improvement	
	No.	%	No.	%
Anloga (71)[a]	69	97.2[b]	26	36.6[b]
Ejura (80)[a]	13	16.3[b]	80	100.0[b]
Wassa (54)[a]	7	13.0[b]	52	96.3[b]
All Areas (205)[a]	89	43.4[b]	158	77.1[b]

Source: S. Y. Atsu, (1990). The Organization and Management of Agricultural Services to Small Farmers in Africa: The Case of Ghana. Report prepared for FAO.

[a]sample size
[b]as proportion of sample size.

Table 32: Distribution of Farmers in Terms of Suggestions for Improving Marketing of Farm Produce.

Suggested Improvements	Anloga (26)* No	%	Ejura (80)* No	%	Wassa (52)* No	%	All Areas (158)* No	%
1. Wider range of buyers	7	26.9	65	71.2	50	96.1	122	77.2
2. Higher prices	23	88.5	80	100.0	52	100.0	155	98.1
3. Respecting buying calendar	4	15.4	55	68.8	47	90.4	106	67.1
4. Onfarm storage	10	38.5	74	92.5	47	90.4	131	82.9
5. Better transportation facilities	5	19.2	79	98.8	52	100.0	136	86.1
6. Collective sales	1	3.8	38	47.5	37	71.1	76	48.1

Source: S. Y. Atsu, (1990). The Organization and Management of Agricultural Services to Small Farmers in Africa: The Case of Ghana. Report prepared for FAO.
* sample size

Table 33: Type Credit Market Used to Secure Fertilizer Loan in Ghana, 1991 main crop season.

Nature of funds/types of credit market	Number of farmors served	% of farmers surveyed
Own cash	39	36.1
Credit from formal market	31	28.7
Credit from informal market	38	35.2
All the farmers	108	100.0

Source: IFDC/IFPRI/ISSER survey data, Computer Printout, IFPRI, Washington, 1992.

Table 34: Sources of Informal Fertilizer Credit in Ghana, 1991 Main Crop Season.

Sources of credit	Number of farmers served	as % of farmers served in the informal market
Money lenders	0	0.0
Family/relatives	19	50.0
Traders	11	28.9
Friends	8	21.1
All the informal sources	38	100.0

Source: IFDC/IFPRI/ISSER survey data, Computer Printout, IFPRI, Washington, 1992.

Table 35: Sources of Formal Fertilizer Credit in Ghana, 1991 Main Crop Season.

Sources of credit	Number of farmers served	as % of farmers served in the formal market
Agricultural Development Bank (ADB)	6	19.4
Ghana Commercial Bank (GCB)	1	3.2
Social Security Bank (SSB)	4	12.9
Credit Union	2	6.5
Pamscad	1	3.2
Maize Farmers Association	1	3.2
Sassakawa Global 2000	13	41.9
IFDC-Africa	3	9.7
All the formal sources	31	100.0

Source: IFDC/IFPRI/ISSER survey data, Computer Printout, IFPRI, Washington, 1992.

CHAPTER 6

CONCLUSION AND POLICY RECOMMENDATIONS

The pattern of fertilizer use emerging from the foregoing analysis is a concentration of the input on cereals. For Ghana as a whole, cereals occupied 72.0 percent of the total fertilized area and claimed 80.1 percent of the total fertilizer nutrients during the 1991 main crop season. This is not surprising, for it reflects government policy of concentrating the limited quantities of fertilizer available on cereals[11]. The wide popularity of cereals as staples, and the availability of appropriate technological packages (including high-yielding seed varieties, fertilizers and improved cereal production practices) were undoubtedly major factors influencing the choice of policy.

The case for concentrating fertilizer use on cereals to the virtual neglect of other crops is becoming increasingly untenable. Agricultural diversification, which is one of the key elements of the structural adjustment program in Ghana, calls for the wider use of fertilizer and other complementary inputs on other crops. The starchy staples, namely cassava, yam and plantain form the bulk of the energy consumed within Ghana. The role of these crops in food security, par-

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[11]Ghana, 1984. Ghana Agricultural Policy: Action Plans and Strategies, 1984 - 1986. Accra.

ticularly for the poorest segments of the population, cannot be overemphasized. The analysis has shown that these starchy staples occupied 1.8 percent of the total fertilized area and claimed a token 0.6 percent of the total fertilizer nutrients during the 1991 main crop season. Even in the agro-ecological zones where such crops feature prominently as staples, they were planted to less than 10 percent of the fertilized area and claimed under 5 percent of the total fertilizer nutrients supplied during the study crop season.

It is urgent for policy makers to reassess the position of various crops in the national economy. They need to redraw the list of priorities with regard to the development and diffusion of agricultural innovations, bearing in mind the strengths and peculiarities of different agro-ecological zones in the country. The government of Ghana must develop a policy framework in order to promote, in a stable and long term manner, the use of fertilizer and other agricultural inputs. Such a framework should aim at encouraging in each agro-econological zone the use of fertilizer on food and export crops that have comparative advantage. This would reduce the divergence between the recommended doses of fertilizer and those effectively used, and accelerating the use of fertilizer on new lands. Policy should also promote the use of this input among small farmers and in areas of low agricultural potential. Improvement of technical skills of farmers, increasing the economic efficiency of fertilizer use and developing agricultural commodity markets, are other policy concerns calling for attention (Tshibaka and Baanante, 1990).

It is derived from this study that currently efforts must be

deployed to enhance research and extension, to improve the availability, distribution and marketing of fertilizers in the various agro-ecological zones in Ghana, to import only fertilizer types which are ecologically and economically suitable and viable. In addition, action is to be taken to introduce no more than 3 fertilizer types in a given agro-ecological zone in order to help a proper use of this input by smallholder farmers. Furthermore, the study has established that there is a need to increase the volume of fertilizer credit to farmers and to make this credit easily accessible, and to improve crop marketing services.

Annex 1: Recommended Rates of Fertilizer Nutrient Application for selected Crop in Ghana (in kgs of NPK nutrients per acre).

Agro-ecological Zones	Cropping History	Maize				Swamp Rice				Uplan Rice				Millet/Sorghum			
		N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O	Total
High Rainfall, Semi-Deciduous, and Coastal Savanna Zones	· Fallow of at least 5 years	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-
	· Fallow of less than 5 years	20	10	0	30	-	-	-	-	-	-	-	-	-	-	-	-
	· Continuous cropping	41	20	0	61	-	-	-	-	-	-	-	-	-	-	-	-
Transitional Zones	· Fallow of at least 5 years	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
	· Fallow of less than 5 years	20	10	0	30	-	-	-	-	-	-	-	-	-	-	-	-
	· Continuous Cropping	41	20	0	61	24	16	8	48	32	16	16	64	-	-	-	-
Guinea and Sudan Savanna Zones	· Land fallowed	20	10	0	30	-	-	-	-	-	-	-	-	-	-	-	-
	· Continuous Cropping	41	20	0	61	24	16	8	48	32	16	16	64	16	16	16	48

Source: Owusu, B (1990) Fertilizer Requirements for some major Crops in Ghana. Manuscript, University of Ghana, Legon.

Annex 2: Selected crop and Fertilizer Prices at village level in Ghana, 1991.

AGRO-ECOLOGICAL ZONE	ADMINISTRATIVE REGION	VILLAGES	MAIZE (Cedis/KG)	RICE (Cedis/KG)	SORGHUM (Cedis/KG)	FERTILIZER NUTRIENTS (Cedis/KG)
HIGH RAINFALL	WEST	Aiyinase	139	211	n.a.	210
	WEST	Daboase	148	n.a.	n.a.	215
	WEST	Kobina Anno-Krom	148	n.a.	n.a.	215
SEMI-DECIDUOUS FOREST	ASHANTI	Adjamasu	112	223	126	224
	ASHANTI	Boamang	102	208	142	240
	EAST	Kade	120	224	n.a.	221
COASTAL SAVANNA	G/ACCRA	Amasaman	102	181	148	235
	CENTRAL	Ojibi	110	177	n.a.	228
	VOLTA	Ohawu	94	203	n.a.	241
TRANSITIONAL ZONE	B/AHAFO	Techiman	75	190	108	269
	B/AHAFO	Atebubu	97	174	84	238
	ASHANTI	Ejura	76	182	93	239
GUINEA SAVANNA	NORTH	Damango	77	n.a.	109	277
	NORTH	Nyankpala	84	142	92	257
	NORTH	Bole	72	205	95	277
SUDAN SAVANNA	U/EAST	Manga	104	190	104	250
	U/EAST	Vea	93	217	104	249
	U/EAST	Tono	95	183	119	244

Sources: Ghana, 1991. Agricultural trice data Ministry of Agriculture, Accra.

Note: Weighted average price of fertilizer nutrients, taking into account the amount and the prices different fertilizer types used in the surveyed village.

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