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SUPPLY RESPONSES OF COTTON FARMERS IN GHANA: CASE STUDY OF NORTHWESTERN GHANA

by

Regina Ohene-Darko
Bureau of Economic Research and Development
Virginia State University
Petersburg, Virginia

and

John Anim-Appiah
Department of Agricultural Economics and Farm Management
University of Science and Technology
Kumasi, Ghana

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Regina Ohene-Darko
Research Assistant
Bureau of Economic Research and Development
Virginia State University
Petersburg, Virginia

and

John Anim-Appiah
Visiting Research Associate of BERD, and
Senior Lecturer, Department of Agricultural Economics
University of Science and Technology, Ghana

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FOREWORD

The period 1972 - 1979 has been for Virginia State University one of institutional development in the general area of rural development. The University's Bureau of Economic Research and Development has been charged with the administration of the institutional development program which focuses on rural development problems in South Central Virginia as well as developing countries. The most worthy program was permitted by a grant under Title II section 211(d) of the Foreign Assistance Act of 1961 as amended.

The centerpeice of the Bureau's rural development research program is an understanding of the socio-economic behavior of the farm-household as well as the capacity of the support systems (e.g. credit institutions and extension service) to meet the needs of the small farmer. The present monograph attempts to enhance our knowledge in these areas. It focuses on the production of cotton in Northwestern Ghana, West Africa. In particular, it seeks to delineate the critical factors affecting the supply behavior of small cotton farmers. The study clearly indicates that small cotton farmers, like other small farmers, are risk averters, rational decision-makers especially with respect to their responsiveness to relative price changes. The study also points up the importance of the support system in small farmer productivity. Thus the results give policy makers clear guidance with which to formulate and evaluate policy options.

Despite the limitations of the study acknowledged by the authors, they must be commended for the positive contributions to the solution of rural

development problems in Ghana and perhaps throughout the developing world.

Michael S. Joshua, Director
Bureau of Economic Research and
Development/Associate Professor
of Economics
Virginia State University
Petersburg, VA 23803

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The authors are solely responsible for errors of fact and opinions expressed.

Regina Ohene-Darko

John Anim-Appiah

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CHAPTER I

INTRODUCTION

Overview of Cotton Production in Ghana

Cotton is the most important of all the vegetable fibres. It is also the oldest of the cultivated fibre crops; it has been grown in India for making clothing dating back to about 3000 B.C. Cotton production in Ghana is reported to have started as far back as the nineteenth century by many villages, especially in the Savannah Region.[1] The lint was ginned by hand and spun at home. The home-spun was then woven and made into the garment smock in the North, and Kente cloth in the South.

It is reported that attempts to develop a viable cotton industry in Ghana were begun in the early 1900s.[2] The work was undertaken by the then Department of Agriculture with the cooperation of the British Cotton Growing Association. Work was centered around the Savannah Regions of Ghana. Large quantities of seeds of different varieties were issued free to farmers and ginneries were also installed. Between 1903 and 1915 there was an export trade in seed cotton between Ghana and the United Kingdom (Table 1.1). However, these early attempts to develop a viable cotton industry in Ghana failed. In the North, the failure was mainly due to low yields, resulting from poor soil conditions and extensive damages by pest and diseases. In the South, the most important limiting factor was the fact that cocoa, kola and oil palm were more successful as cash crops than cotton.

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[1]G. S. Cottrel (1928). "Cotton Pests of Southern British Togoland and Trans Volta District." Bulletin of the Department of Agriculture, No. 12, Accra, Ghana.

[2]*Ibid*.

Table 1.1

EXPORT TRADE IN SEED COTTON BETWEEN

GHANA AND THE UNITED KINGDOM 1903-1915

Year	Quantity (lbs.)
1903	10,340.00
1904	51,143.40
1905	28,833.20
1906	91,759.80
1907	55,528.00
1908	51,009.20
1909	30,978.20
1910	11,305.80
1911	9,603.00
1912	20,191.60
1913	27,225.00
1914	23,278.20
1915	12,555.40

Source: Ghana. Cotton Development Board, Tamale: Unpublished Records.

Present day cotton growing was revived in 1962 by the State Farms Corporation of Ghana and the Crops Research Institute of Ghana, which experimented on ways of cultivating cotton to promote it as a cash crop in fulfillment of the Seven Year Development Plan of the Kwame Nkrumah Government, which set a target of 2,000 tons of seed cotton by 1970.

Meanwhile, printed cotton cloth introduced from Europe had become an important aspect of traditional clothing. The growing importance of the printed cloth demanded an ever increasing amount of foreign exchange. Aware of this, the government built a spinning and weaving factory at Tema. Ghana at present has five textile factories (three at Tema and one each at Akosombo and Juapong). Though cotton was grown in the country, the quantity was not enough to supply the raw cotton needed by the mills. In view of this, the State Farms Corporation grow several hundred hectares of the crop. Unfortunately, the technical problems were many and again yields were low.

A clear potential for commercial cotton growing has been revealed by research carried out by the Crops Research Institute.[3] Encouraged by this, the National Liberation Council (NLC) Government accepted a recommendation from the Food and Agriculture Organization (FAO), and the need to reduce the pressure on the foreign exchange reserves led to an action to stimulate farmers interest in the crop. The Cotton Development Board was, therefore, established in 1968 as an agency for planning and promoting cotton cultivation on a commercial basis to meet the national demand through intensified extension work, free input supply and producer price support, and thus conserve foreign exchange. Beside supplying the textile factories with the raw material, commercial cotton growing was expected to establish a new source of income for farmers and create more job opportunities for the people.

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[3]Crops Research Institute, Kumasi, Ghana - Unpublished Records.

Importance of Cotton in Ghana's Economy

Cotton is an important crop in the Ghanaian economy. Ever since the introduction of cotton cloth into the country, cotton has been the most important textile used in clothing by most Ghanaians. Ghana for some time has spent large sums of foreign exchange on the importation of the commodity into the country and also the lint for the textile factories. Though the level of cotton production in the country is on the increase as shown in Table 1.2, it is not known exactly what is the total demand for cotton in Ghana. Various estimates have been given. In the Five Year Development Plan, it is estimated that domestic output expressed as a percentage of existing factory was 2.1, 6.3 and 8.2 percent for 1972, 1973 and 1974, respectively. These figures would imply domestic lint demand of 12,550 - 37,900 metric tons (this is equivalent to 33,206 - 99,757 metric tons seed cotton). Recently the Cotton Development Board has estimated the current (1977/78) domestic demand at 100 million pounds seed cotton (50,000 metric tons).[4] The estimates by the Cotton Development Board as seen from Table 1.2 shows that a greater proportion of raw material, however, is supplied through imports.

In the 1970 sample census of agriculture, it was estimated that of the total of 805,200 holdings in the country, 2,500 were devoted to cotton production, over 1,300 of which were found in the Wa District alone.[5] Farmer's earnings from cotton production have increased from ₵11,012 to ₵7,715,760 between 1968/69 and 1976/77.[6] Export of cottonseed has also contributed to foreign exchange earnings (Table 1.3). In the North, therefore, where there

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[4]Ghana, Economics and Marketing Division: Ghana Sample Census of Agriculture, 1970. Vol. 1, Accra, 1971.

[5]Z. Andan, "A Review of Cotton Development Boards' Activities from 1972-76." - Ghana, Cotton Development Board. Tamale.

[6]Ibid.

Table 1.2

COTTON PRODUCTION IN GHANA, 1968/69-1976/77

Season	Area Cultivated Acres	Production (lbs)	Percentage of Demand Supplied Locally*
1968/69	420	220,240	0.22
1969/70	1,742	586,424	0.59
1970/71	2,207	920,861	0.92
1971/72	4,806	2,713,863	2.71
1972/73	9,168	4,189,843	4.19
1973/74	10,833	5,416,500	5.42
1974/75	11,024	6,614,400	6.61
1975/76	32,100	19,902,000	19.90
1976/77	59,100	22,045,200[a]	--

Source: Ghana, Cotton Development Board, Tamale; Unpublished Records.

*Assumes domestic demand of 100 million lbs. seed cotton. See footnote 5.

(a) Output for part of the year only.

are only a few cash crops, farmers can earn more from cotton and enjoy a higher standard of living. There are also more jobs for the rural people because of increased labor requirements on the farms and at the ginneries.

The Problem

The Government's increased attention to the need for an early attainment of self-sufficiency in cotton production has led to an increase in its subsidies to the program. In the 1971-72 crop season, an amount of ₵75,000 was spent on the supply of farm inputs to the farmers and this has increased over the years to as much as ₵2,350,000 in the 1976-77 crop season.[7] The producer price of seed cotton has increased from ₵0.05 per pound in 1968-69 to ₵0.35 per pound in the 1976-77 crop season with a corresponding increase in government subvention to the Cotton Development Board from ₵401,000 in the 1974-75 season to ₵7,800,000 in the 1976-77 crop season.

Research has indicated that certain areas in Northern, Upper, Volta, Ashanti and Brong Ahafo Regions have the right climatic and soil conditions as well as the available land necessary for the successful cultivation of cotton in appreciable quantities large enough to meet demand. However, despite the program of subsidization which has been in effect over the last ten years, the production of cotton has been able to meet only 20 percent of the demand, necessitating substantial amounts of foreign exchange for importation; and the Cotton Development Board is yet to achieve its objective (i.e., production of lint cotton locally to supply the needs of the local textile mills and help conserve foreign exchange).

The purpose of this study is to examine the cotton industry's behavior with a view of determining the relative importance of the various factors

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[7]Following the massive devaluation of the cedi in September, 1978 the conversion rate is now ₵1.00 = U.S. $0.36.

Table 1. 3

EXPORT OF COTTONSEED, 1969/70-1976/77

Year	Quantity (metric tons)	Value ¢
1969/70	140.18	7,077.56
1970/71	223.22	15,844.13
1971/72	440.47	42,550.00
1972/73	720.72	80,384.11
1973/74	695.69	89,604.55
1974/75	709.45	106,538.99
1975/76	446.43	51,750.00
1976/77	892.86	103,500.00

Source: Ghana, Cotton Development Board; Tamale; Unpublished Records.

that affect farmers supply decisions and to delineate strategies to stimulate the required expansion of the industry.

Objectives of the Study

The general objective is to develop a framework to determine the quantitative and/or qualitative importance of the factors that determine cotton supply in Ghana.

The specific objectives are:

1. To examine the socio-economic environment underlying cotton production;
2. To identify the factors affecting cotton production by developing a supply model;
3. To evaluate the quantitative importance of these factors;
4. To determine which factors are responsible for the present low level of cotton production.

Methodology

The first specific objective was accomplished by conducting a field survey to determine the basic characteristics of the cotton farmers which are likely to influence their production decision-making. This included discussions with the staff and officers of the Cotton Development Board, the Ministry of Agriculture and the Agricultural Development Bank. Based on the above, objective (2) which involves the development of a supply response model, was achieved using multiple regression analysis after identifying the factors determining cotton supply. Objective (3) was accomplished by testing the parameters of the supply response equations developed, using time series data obtained from reports and records of the Cotton Development Board and the Central Bureau of Statistics and from other secondary sources. Objective (4) was accomplished by examining the evidence of the regression analysis supplemented by the results of the field work.

The Study Area

The Wa area of the Northern Development Agency of the Cotton Development Board (CDB) was chosen as the study area. (See Figure 1.1). This area covers the Tumu, Lawra, Bole and Wa Agricultural District of the Upper Region of Ghana.

The area was chosen for the following reasons: 1)It is the most important cotton producing area in the country in terms of acreage cultivated, yields and experience of the cotton farmers, and representative factors that affect cotton production in the country. 2)Out of the total 59,100 acres of cotton cultivated in the country during the 1976/77 season, 12,864 acres were cultivated in this area, and 3) of the 9,951 metric tons seed cotton produced in 1975/76, the area contributed approximately 2,450 metric tons representing about 22 percent and 25 percent of total area and total output, respectively.[8]

With the establishment of the Cotton Development Board in 1968, the Wa Agricultural District, within the study area was the first to successfully grow cotton as a cash crop, and this success has since spread to Tumu, Lawra and Bole Districts all in the study area.

The study area is also served with an area office of the Cotton Development Board which can be depended upon for official production figures and other relevant data on cotton production. It also serves as a source of the necessary extension contact for the farmers which leads to better farming practices and higher yields.

Another important aspect of cotton production in the study area has been the ever-increasing output recorded over the years, which has increased from 2.91 metric tons seed cotton in the 1968/69 season to 3,334.47 metric tons in the 1976/77 season (see Table 1.4). The area also cultivates other crops,

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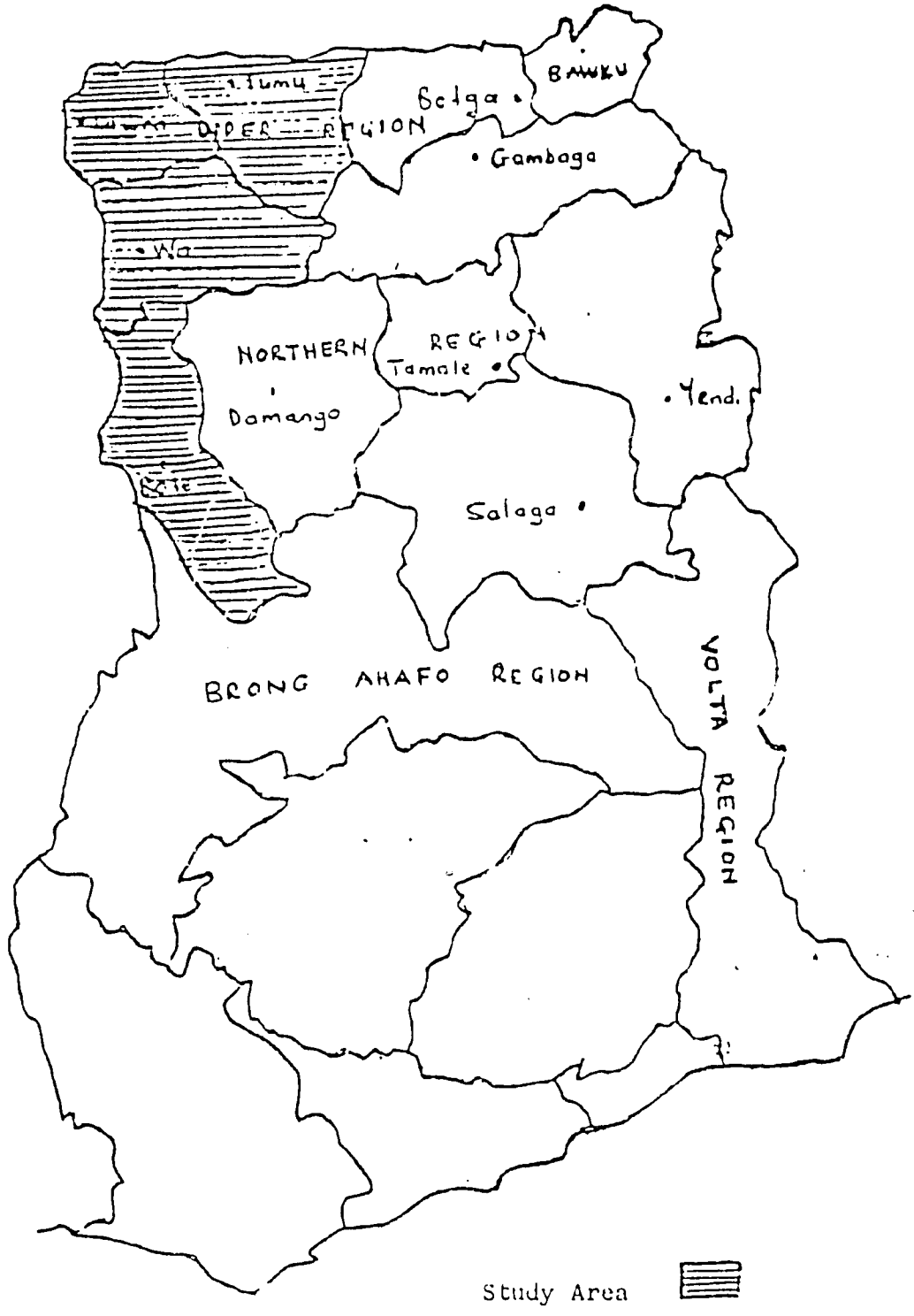
[8]Ghana, Cotton Development Board, Tamale; Unpublished records.

FIGURE 1.1

Administrative Map of Ghana Showing Northern and Upper Region Agricultural Districts



Source: Adapted from a map prepared by the Ministry of Agriculture, Accra, Ghana.

Table 1.4

COTTON PRODUCTION IN NORTHWESTERN GHANA,

PERFORMANCE BY DISTRICTS (IN METRIC TONS)

District	1968/69	1969/70	1970/71	1971/1972	1972/73	1973/74	1974/75	1975/76	1976/77
Wa	2.91	10.99	125.91	294.35	243.35	78.05	86.37	797.39	527.94
Bole	--	--	3.23	5.22	141.20	17.61	14.42	103.15	129.40
Lawra	--	--	38.14	105.83	66.23	94.18	250.72	379.58	503.51
Tumu	--	1.68	29.98	105.44	285.27	219.43	304.32	1,176.22	1,787.46
		--	--	--	--	--	--	--	276.16
Total	2.91	12.67	197.26	510.83	736.05	409.28	655.79	2,456.34	3,334.47

Source: Ghana, Cotton Development Board, Tamale; Unpublished Record.

such as guinea corn, millet, groundnuts, beans, yams and a host of other minor crops.

The Survey

The field survey was carried out in order to develop a specific framework for the study by identifying the basic characteristics of the cotton farmers with respect to age, sex, educational background and risk aversion and how these relate to the factors of land, labor and capital used in cotton production. Information on alternative crops cultivated and their relative profitability, acreages and yields; availability of inputs, labor and credit facilities; methods of land acquisition and land preparation and the marketing of cotton were also required. The questionnaire - interview method was used involving 200 randomly selected cotton farmers in the study area.

CHAPTER II

THE SOCIO-ECONOMIC CONDITIONS OF COTTON PRODUCTION IN THE STUDY AREA

The types of crops that are grown in an area and the quantities produced are influenced by the physical, social and economic conditions prevailing in that area. Given the physical conditions, the actual crop choice of the farmers would depend on the socio-economic conditions.

This chapter examines the socio-economic conditions underlying cotton production in the study area with reference to the Cotton Development Board as the agency responsible for promoting the cotton industry in Ghana.

Organization of Cotton Production

Since the inception of the Cotton Development Board (CDB) in 1968, cotton development and production in Ghana has been under its umbrella. The production area of the CDB is divided into two agencies - the Northern Development Agency, which covers the Northern and Upper Regions, and the Southern Development Agency covering Brong Ahafo, Ashanti and Volta Regions.

Farmers are registered by the Board through its seasonal campaigns which are usually carried out during December and January. There is an integration between the cotton farmer and the Cotton Development Board's extension unit. The farmer is supplied with free seeds, fertilizer, insecticides and spraying equipment, as well as village level extension. The quantities of each input of seeds, fertilizers and insecticides allocated to each farmer depends on the recommended optimum quantities per acre, the total area cropped, and the quantities of inputs available. Measures are taken to ensure that the

optimum or at least near optimum quantities of inputs are allocated to farmers. One such measure is that farmers are made to reduce their farm sizes when a shortage of any of these inputs for any particular season is anticipated.

Farmers are not responsible for input handling and transportation costs during the distribution. The only cost they may incur would be in moving their supplies from the nearest cotton production station to their homes, either on bicycle or by head porterage. The Board ensures that cotton production does not displace food production in the Northern and Upper Regions by first inspecting these food crop farms before inputs for cotton production are provided. The Cotton Development Board is the sole buyer of cotton produced by the farmers. Marketing of seed cotton takes place at specified depots located in each of the cotton producing villages, and farmers are responsible for carrying their produce from their homes to the depots where their products are weighed and purchased.

Extension services are rendered free through the extension staff of the Cotton Development Board. There is a hierarchy of production staff by which instructions are relayed from the Chief Administrator to the cotton farmer. Junior members of the hierarchy actually do the field work. They are divided into three groups. At the bottom is the Cotton Production Assistant (CPA) who is directly in charge of the farmers in a village, teaches farmers the relevant cultural practices involved in cotton production, (directly on their farms) and takes part in the marketing campaign of seed cotton. Above the CPA in rank is the Cotton Production Supervisor, who is in charge of a number of villages. Higher still is the Cotton Production Officer as the head of a sector made up of two or more districts, and supervises the work and training of the Cotton Production Supervisors and Cotton Production Assistants.

Socio-economic Characteristics of the Cotton Farmers

The successful cultivation of any industrial crop on a large scale depends partly on the nature of the farmers who grow the crop. In the case of cotton, which in recent years has called for substantial governmental attention, its production will depend on certain basic characteristics affecting the farmers decision-making and their response to economic incentives. The conditions under which cotton is produced in Ghana can best be explained by discussing the socio-economic factors affecting the typical cotton producer. This section summarizes the results of the field work, supplemented by the authors' experience and knowledge of the socio-economic conditions in the study area.

The study showed that the typical cotton farmer is 45-50 years, has been in farming for 30 years and has grown cotton for about four years (Table 2.1). About 85 percent of the farmers have never had any classroom education at all, indicating a very low level of literacy. Of those who had been to school, only 3 percent have had more than secondary school education (Table 2.2). The age structure showed only a few young cotton farmers in the area. There were 82 percent of the farmers within the age range of 30-69 and over, and 34 percent of these were over 50 years.

With regards to labor, it was found that the most important source of labor to the cotton farmer is family labor. About 71.5 percent of the total labor came from family labor with an average of about 7 persons per family. The next important source of labor was daily hired labor representing about 22 percent of the total labor requirements. Farmers, however, had to contend with migration to urban areas as well as difficulties in recruitment and supervision of hired labor. Hired labor was found to be either unavailable when needed, or expensive or both, and farmers have to utilize the family

Table 2.1

AGE STRUCTURE OF FARMERS IN THE SURVEY

Age (Years)	No. of Farmers	Percentage
Under 20	1	0.5
20 - 29	35	17.5
30 - 39	61	30.5
40 - 49	47	23.5
50 - 59	38	19.0
60 - 69	13	6.5
Over 69	5	2.5
Total	200	100

Source: A survey of cotton farmers in the Wa Area of Ghana conducted in November 1977 by the senior author.

Table 2.2

EDUCATIONAL BACKGROUND OF THE FARMERS

Educational Level	Number of Farmers	Percentage
Illiterates	170	85
Primary School	2	1
Middle School	18	9
Secondary School	4	2
Above Secondary	6	3
Total	200	100

Source: A survey of cotton farmers in the Wa Area of Ghana conducted in November 1977 by the senior author.

labor available. The farmers explained that the Aliens Compliance order had drastically reduced the labor supply in the area. Local labor supply was short of demand causing wages to rise. Again the present minimum wage of ₵4.00 per day (1977) was considered too high by farmers, and since they could not afford to pay the minimum wage to the laborers, most of them (laborers) had been attracted to towns and cities where they could earn the minimum wage. The farmers, therefore, had no choice but to depend on their families and, if the need arose, relied on daily hired labor rather than any permanent source of hired labor. The daily labor was usually labor from farmers who occasionally made themselves available during the periods when they did not have much work to do on their own farms. Only 5 percent of the respondents employed full-time laborers and these farmers were mostly old and experienced farmers who had accumulated a lot of money over the years through their numerous farm holdings. Owing to the high cost of labor, it appeared to be the most important cost on the cotton farm.

Land in general was not considered to be a limitation to cotton production. Most of the farmers had access to land by virtue of their being citizens of the area. Eight-one percent of the farmers claimed that they had access to their plot of land due to family or clan rights, 12 percent indicated that the land was given to them as gifts, and 3 percent inherited the land from their parents. Only 2.5 percent "purchased" the land and one percent farmed on communal lands.

Land preparation in the study area was found to be almost completely carried out by the use of traditional implements. The short handled hoe is by far the most important agricultural implement, being used in clearing the land, preparing the soil, planting, weeding and for harvesting. Almost 95 percent of the respondents employed the traditional hoe in their farming

operations and the remaining 5.5 percent used tractors. The reasons for not using tractors were mainly due to the lack of funds, the unavailability of tractors, or both. Frequently, knives and cutlasses are used in addition to the hoe.

Farm inputs such as seeds, fertilizers and insecticides for cotton cultivation are supplied free by the Cotton Development Board (CDB). These are transported by the CDB vehicles, to the various depots in the cotton producing villages and distributed to the farmers at no cost to them. The only cost encountered by the farmer is the transportation of these inputs from the depots to their homes which usually covers only short distances. Sprayers for insecticides are provided by the CDB and collected from the farmers at the end of the season.

With regard to credit, 81.5 percent of the farmers interviewed indicated that they depended on their own savings for financing their farming operations. Ten percent depended on their family and friends and 8.5 percent on moneylenders. No form of institutional credit was used by the farmers. Most of them expressed the desire to use institutional credit if it could be made available to them. Although there is a Branch of the Agricultural Development Bank (ADB) at Wa, an interview with a projects officer of the bank revealed that they did not give loans to cotton farmers since cotton production was solely the responsibility of the CDB. Seventy-five percent of the farmers stated that they had never borrowed money for farming purposes and gave several reasons for it. These included their inherent fear of debt, unavailability of alternate sources to borrow from, and the high interest rates charged by moneylenders. Others did not, in principle, favor the idea of borrowing. Only 2 percent of the farmers, however, stated that they were self-sufficient and did not need any loan.

Extension services were found to be effective in cotton production. All of the farmers depended on extension officers for the delivery and distribution of fertilizers, insecticides and seeds as well as demonstrations of improved farming operations. The extension officers visited their farms at least once a week and most of the farmers were very appreciative of the assistance given by these extension officers. Some of the service provided by these extension officers include the distribution of farm inputs, technical advice as to the right use of fertilizers and insecticides, demonstrations on farmers' own farms and others. These extension officers (Cotton Production Assistants), live with the farmers in their villages and are, therefore, available for help almost always on call at any time. About 3 percent of the farmers did not see the usefulness of the extension officers although they all acknowledged the fact that they were visited at least once a week by them.

So far as the marketing of cotton is concerned, all the farmers stated that their produce was bought solely by CDB officers at the end of the harvesting period and no major problems were encountered in disposing of their produce. The CDB marketing team came to their villages to buy their seed cotton. All they had to do was to carry their produce to the weighing points usually by head porterage. At these points, the seed cotton is weighed and the weight recorded.

The main complaints of the farmers were delays in the purchasing of the seed cotton, and frauds during weighing. Farmers alleged that because they are ignorant about the weighing system they had the suspicion that they were often cheated by officials during weighing, and that they usually got much less from their produce than what they had expected. They also complained that there are times when their produce were not purchased in time, and

because they did not have adequate storage facilities this resulted in damage due to insect and rodent attack which led to a loss in income.

Concerning the guaranteed price set by the CDB, all the farmers were in favor of guaranteed price because this assured them of some income at the beginning of the season. They, however, considered the price of ¢0.35 per pound of seed cotton (1977) low and wanted prices to be increased commensurate with the present high production cost, especially with respect to labor

Cotton cultivation is not the only occupation of the cotton grower. It is the policy of the CDB that farmers do not grow only cotton, but other crops as well, especially food crops, to prevent cotton from displacing food crop production in view of the present high cost of food in the country. Another policy of the CDB, aimed at improving the productivity on the cotton farms is the limitation set on the size of the cotton farm each farmer can cultivate. The CDB at the discretion of its field officers, tries to limit the operation of each cotton farmer to the size which it believes the farmer, given his previous performance and experience and the availability of inputs, would be able to maximize his output.

The major crops grown by the cotton farmers in the area include millet, guinea corn, yams, groundnuts, beans and rice (See Table 2 .3). Of these crops, including cotton, 35 percent of the farmers indicated guinea corn to be most profitable. Thirty percent mentioned cotton and 18.5 percent found millet most profitable. The least profitable crop according to the farmers was rice - only 1.5 percent of the farmers indicated it to be the most profitable crop. Guinea corn would thus seem to pose as the most important alternative to which cotton farmers can employ their land and labor.

A few of the cotton farmers were found to be engaged in other economic activities apart from farming. Some of them operate as traders, native

doctors, school teachers, tailors and government workers. Some also work as laborers on new government buildings, roads and other such employment. Seventy-six percent of all the farmers were full-time farmers who did not engage in any other economic pursuits. Of the 24 percent who were engaged in other income earnings activities, 12 percent were full-time government employees who grew cotton as a sideline, 10 percent were traders and the remaining 2 percent were made up of tailors, native doctors, preachers, moslem leaders, craftsmen, etc.

So far as the new minimum wage is concerned, only 14 percent of the farmers expressed the desire to leave their farms and their villages to seek employment in the cities. The remaining 86 percent, however, did not consider the ¢4.00 per day minimum wage as enough money to make them leave farms and villages for the big towns and cities. The minimum wage was considered to be inadequate even to provide them and their families with their daily food needs - not to mention the questions of clothing and shelter.

When asked what has limited them to the size of cotton farm they cultivated, 17 percent attributed the size of their farms to the Cotton Development Board's policy on acreage restriction, 3.5 percent to the high level of management required for cotton cultivation, 10.5 percent to high labor requirements for cotton and 1.5 percent to the unavailability of the needed inputs. Sixty-seven percent of the farmers were not interested in increasing the size of their farms. They preferred to maintain small acreages and rather increase their productivity per acre of cotton cultivated. Most of them asserted that cotton requires such a great deal of attention that a smaller farm was easier to maintain for higher yields. The produce from a larger farm, on the other hand, may all be lost if the farm does not get the

Table 2.3

TYPES OF CROPS GROWN BY THE SAMPLE OF FARMERS IN THE SURVEY

Crop	No. of Farmers Growing Crop	Percentage
Guniea Corn	131	65.5
Millet	127	63.5
Yam	125	62.5
Groundnuts	86	43.0
Beans	81	40.0
Rice	23	11.0

Source: A survey of cotton farmers in the Wa Area of Ghana conducted in November 1977 by the senior author.

requisite attention. The farmers preferred to devote more acreage to food crops on which they depended for their daily sustenance, rather than to cotton which, according to them, can not serve as food. Food crops were grown mainly for subsistence and only surpluses beyond consumption requirements were marketed. It is possible, according to the farmers, that even with cash in their hands food may not be available for purchase and, therefore, they found it necessary to satisfy their primary objective - grow enough food to feed themselves and their families.

The above discussion of the survey of the study area shows that cotton farmers in the study area are confronted with many socio-economic circumstances, some of which lie beyond their control, and all of which affect their decision-making and the extent to which they devote resources to cotton production. These include the unavailability of labor, the high labor cost, and the high labor requirements in cotton cultivation; lack of adequate credit facilities; the unique role of the Cotton Development Board with regard to the distribution of inputs such as seeds, fertilizers and insecticides; the provision of extension services; the policy on acreage restriction; and the guaranteed producer price for cotton. Others include the alternatives to which the farmer can employ his resources of land and labor; and the farmers' subjective risk preference in decisions involving the production of crops, in particular, production for consumption versus production for cash.

Having examined the conditions under which cotton is grown in the Wa area of Ghana, an attempt is made in the next two chapters to determine the quantitative importance of some of the factors influencing cotton production.

CHAPTER III

THE MODEL OF COTTON SUPPLY RESPONSE

Models, Variable Specification, Data and Sources

Supply response analysis has traditionally proceeded by using either acreage or output as the dependent variable. Many studies have used acreage rather than output on the basis of the fact that the farmer is more likely to be in a position to control acreage rather than output.[1] Both acreage and output were used as dependent variables in this study.

The basic equations used in the study were comprised of an output response model and an acreage response model as follows:[2]

(1) $Q_t = f_1(P_t, PC_t, FS_t, UW_t, PI_t\ W, S)$

(2) $A_t = F_2(P_t, PC_t, UW_t, S)$

where,

Q_t = output of cotton in year t,

P_t = producer price of cotton is year t,

PC_t = producer price of competing commodities in year t,

FS_t = average farm size per cotton farmer in year t,

UW_t = urban wage in year t,

PI_t = price of cash goods in year t,

W = weather, and

S = extension services.

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[1]See Marc Nerlove, The Dynamics of Supply; Estimates of Farmers Responses to Price, Johns Hopkins University Press, Baltimore, 1958. J. Anim-Appiah "Aggregate versus Disaggregate Acreage Supply Response Models for Prairie Wheat and Barley," Unpublished Ph.D. Dissertation, University of Manitoba, Winnipeg,

[2]Detailed explanation regarding these models can be obtained from Regina Ohene-Darko, "Supply Responses of Cotton Farmers in Ghana: A case Study of Wa Area", Unpublished M. Sc. Thesis. Department of Business and Economics, Virginia State University, May, 1979.

Since there is no known theory relating the dependent variable and the independent variables used in the study, it was decided to use a linear and double logarithmic functional form. Least squares regression was used as the estimating technique.

Of the commodities that compete with cotton in terms of labor and to some extent land, guinea corn was considered the most important. This is in line with the farmers' own valuation of profitability of the crops grown in the area. Accordingly, guinea corn price was the only proxy used for competing commodities in the equations that were estimated.

The effects of technology, extension services and changes in risk preference are assumed, by their nature, to be gradual through time. A trend variable (T) was, therefore, specified in the final equations to be estimated to account for these effects over time. Starting with the year 1969, the values "one" through "nine" were assigned to each successive year to account for the values of T.

Theoretically, the prices influencing farmers' supply responses are those expected to be operative at the time they market their produce. In many situations, these expected prices are not known at the time of seeding. In the case of cotton, the CDB fixes the prices that will be paid for cotton deliveries to the Board. Sometimes these prices have remained unchanged throughout one or two growing seasons. At other times, however, new price announcements are made after the crop had already been seeded. This leads the cotton farmer guessing what price he will receive when he markets his cotton. However, expected prices are not directly observable. In order to convert the unobservable expected prices into observable ones, the Nerlovial price expectation model was assumed. This gives rise to the often referred

to 'dynamic' and 'static' models.[3] The consumer price index was used as a proxy for the price of cash goods.

The type of analysis outlined for this study required regional and national level secondary data. Times series secondary data for a nine-year period (1969-1977) were collected. Since all the data needed for the study were not available from one source, various sources were consulted to obtain the necessary information for the regression analysis.

Information on acreage of cotton planted and the quantity of cotton produced by farmers in the study area and at the national level were available from the records of the Cotton Development Board's head office in Tamale. These were available for the years 1969 when commercial cotton production was started, to 1977 when the data were collected for the study. The price paid for cotton in any given season was also available from the CDB which is responsible for fixing the price.

Data on the price of guinea corn were obtained from the records of the Ministry of Agriculture's Crop Production Division Office at Wa.

The Central Bureau of Statistics responsible for compiling data on the national economy was the source of information on the daily minimum wage and consumer price index. Figures for these variables were available for the years 1969-1977.

With respect to weather, a discussion held with the Cotton Production Officer at Wa revealed those years in which the weather was relatively good and those that were relatively bad over the period of 1969-1977. The value

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[3]See Marc Nerlove, Dynamics of Supply, op. cit. See also J. Anim-Appiah, "Aggregate versus Disaggregate Acreage Response Models for Prairie Wheat and Barley", op. cit.

'one' was assigned to years in which weather appears to have been average or good for cotton, and the value 'zero' otherwise.

Summary

By way of summary, therefore, we have

(1) $Q_t = f_1(P_t, PC_t, FS_t, UW_t, PI_t, W, S)$

(2) $A_t = f_2(P_t, PC_t, UW, S)$

where all variables are as previously defined. With the conclusion of the disturbance term and respecification of variables, equations (1) and (2) become

(1a) $Q_t = f_3^e(P_t^e, PG_t^e, FS_t, UW_t, PI_t, T, e_t)$

(2a) $A_t = f_4^e(P_t^e, PG_t^e, UW_t, T, e_t)$

where all variables are as previously defined and

P_t^e = expected price of cotton in year t,

PG_t^e = expected price of guinea corn in year t,

T = time trend, and

e_t = the disturbance term.

Finally, with the assumption of the Nerlovian price expectation model, we have the following:

Output models:

(1b) $Q_t = f_5(P_{t-1}, PG_{t-1}, FS_t, UW_t, PI_t, T, e_t)$

(1c) $Q_t = f_6(P_{t-1}, PG_{t-1}, FS_t, UW_t, PI_t, T, Q_{t-1}, e_t)$

where (1b) and (1c) are the static and dynamic models, respectively.

Acreage models:

(2b) $A_t = f_7(P_{t-1}, PG_{t-1}, UW_t, T, e_t)$

(2c) $A_t = f_8(P_{t-1}, PG_{t-1}, UW_t, T, A_{t-1}, e_t)$

where (2b) and (2c) are the static and dynamic models, respectively.

Ordinary least squares was applied to equations (1b), (1c), (2b) and (2c). Because of the shortness of the time series, not all variables could be included in a particular equation as developed above. Various combinations of variables were tried for each equation. These equations were estimated for both the Wa area and for Ghana as a whole. The results of these estimations are presented and discussed in the next chapter.

CHAPTER IV

RESULTS OF THE STUDY

The results of the regression analysis are presented in Table 4.1 and Table 4.2 for Wa and Ghana, respectively. The coefficients of multiple determination (R^2 and $\bar{R}^2$), the t statistics and the F statistics are given for each equation. A total of twenty equations are presented for Wa and Ghana. As stated in the previous section, several equations and functional forms were experimented with. Those presented in the tables gave the most satisfactory results. In general, the equations using the logarithms of the of the variables were not as good as those utilizing the actual variables and have not been presented. In Table 4.1, acreage is the dependent variable for equations 1-5, while equations 6-10 have output as the dependent variable. Similarly, acreage is the dependent variable for equations 11 - 15 in Table 4.2, while output is the dependent variable for equations 16 - 20.

In general, most of the equations when fitted to the available data yielded very good results. Most of the variables had the expected signs and a large number of coefficients were also signigicant.

In the Wa acreage model, the coefficient of the price of cotton had the expected positive sign in all the equations tested and was significant at least at the five percent level. The coefficient of price of guinea corn also had the expected negative sign in each equation and was significant in almost all equations at least at the 10 percent level.

TABLE 4.1 REGRESSION RESULTS: WA AREA[1]

Equation No.	Dependent Variable	P_{t-1}	PG_{t-1}	UW_t	A_{t-1}	Q_{t-1}	T	Constant	R^2	$\bar{R}^2$	F Value
1	Acreage	15860.96 (2.872)*			1.135 (3.03)*			-853.59	0.910	0.870	25.440**
2	"	23889.86 (4.993)**	-112717.51 (2.202)(0)		-0.351 (0.351)		2407.69 (1.61)(0)	-1548.14	0.978	0.948	32.750**
3	"	38682.31 (4.385)**	-65391.78 (2046)(0)	-555.50 (2.032)(0)				4138.02	0.889	0.805	10.655*
4	"		-75998.36 (1.750)(0)				2615.65 (3.30)**	-2586.17	0.791	0.708	9.486*
5	"	23732.63 (5.639)**	-96034.93 (5.779)**				1899.46 (5.899)**	-1173.88	0.977	0.959	55.880**
6	Output	1597519.17 (6.310)**	-2415473.25 (2.412)*				517659.04 (2.2672)**	-69950.78	0.975	0.956	51.892**
7	"	13053906.71 (6.641)**				0.490 (2.957)*		-321836.56	0.974	0.963	91.928**
8	"	20401759.69 (7656)**	-1852654.30 (1.919)(0)	-189352.05 (2.293)*				971146.82	0.970	0.947	42.897**
9	"	18644339.10 (5.368)**	-4748390.13 (0.402)					-141159.24	0.930	0.902	33.326**
10	"	14644339.10 (4.233)**					178993.13 (0.957)	-744334.20	0.939	0.914	38.157**

1. In the table above, significant levels are represented as follows:

(*) Indicates significance at 5 percent level Figures in parenthesis are t values. The one-tailed test was used for t.

(**) Indicates significance at 1 percent level and, (0) indicates significance at 10 percent level. No other levels of significance are represented.

TABLE 4 . 2 REGRESSION RESULTS: GHANA[1]

Equation No.	Dependent Variable	P_{t-1}	PG_{t-1}	UW_t	A_{t-1}	Q_{t-1}	T	Constant	R^2	$\bar{R}^2$	F Value
11	Acreage	67908.47 (4.792)**			1.15 (6.254)**			-3320.19	0.983	0.976	145.99**
12	"	101726.83 (5.702)**	-198226.99 (1.889)0		0.64 (1.636)0		3314.59 (1.330)	-3914.24	0.994	0.987	134.985**
13	"	160990.50 (4.034)**	-86381.38 (0.731)					498.96	0.865	0.812	16.432**
14	"	106075.39 (2.571)*					2172.75 (0.723)	-7852.75	0.876	0.826	17.511**
15	"	124205.20 (9.167)**	-353292.68 (6.604)**				7184.22 (6.883)**	-7196.99	0.990	0.981	126.230**
16	Output	49674503.67 (17.228)**					1239815.47 (1.903)*	-3040287.92	0.997	0.995	508.585**
17	"	52811477.60 (8.243)**				0.256 (1.895)0		-723616.12	0.983	0.976	141.810**
18	"	46513612.49 (13.080)**				0.106 (1.338)	804078.54 (4.018)**	-2724569.24	0.996	0.993	386.24**
19	"	48501757.40 (13.950)**					935656.93 (4.988)**	-3080549.55	0.995	0.993	499.482**
20	"	4720308.20 (12.223)**		-908181.00 (0.766)		0.234 (1.223)	829780.28 (3.877)*	-218934.66	0.997	0.993	259.883**

1. In the table above, significant levels are presented as follows:
(*) indicates signifance at 5 percent level, (**) indicates significance at 1 percent level and,
No other level of significance are presented. (0) indicates significance at 10 percent level.
Figures in parenthesis are t values. The one-talled test was used for t.

Similarly, the urban wage variable gave good results in the equation in which it was featured. In each case, it was significant at least at the 10 percent level and had the theoretically expected negative sign. The trend variable, representing the extension services, technology and other influences over time was significant in most equations and indicated a positive trend. The coefficient of size of farm variable did not perform well in the experiments conducted.

The above statements hold as much for output as for acreage. The output equations tended to be very marginally better than the acreage equations in terms of magnitude of the t-value of the estimated coefficients and the size of the R^2.

The coefficient of the lagged dependent variable tended to be positive and statistically significant (from zero) in most of the acreage equations. In the output equations, however, it tended to be insignificant (from zero) in most equations. To test whether or not it was significantly different from one in the acreage models, confidence intervals were set on it- a test which at once kills two birds in one shot. To provide support for the distributed lag hypothesis the coefficients of the lagged dependent variable must be significantly different from either zero or one. It turned out generally that the coefficient of adjustment was not significantly different from either zero or one in the output and the acreage response models, respectively.

Generally though the R^2 tended to be slightly higher for the dynamic model than for the corresponding static model indicating that the dynamic models have a higher explanatory power. However, we must heed the warning

by Brandow[1], Griliches[2] and other researchers that, if economic variables have a high degree of inertia, lagging the dependent variable and using it as explanatory variable will automatically give a high R^2. On the other hand, it has been argued that introducing the dependent variable with a lag provides a crude test of the overall results. It is pointed out that significance of the coefficients of the other variables in the presence of the lagged variable lends greater credibility than would have been the case if the lagged variable were not present. On the basis of this remark, the results of the regression analysis are, therefore, very satisfactory in terms of statistical significance of the coefficients.

All the above statements apply equally to the national data with minor deviations. The urban wage and the price of guinea corn variables did not perform well in the national models. This is, however, not unexpected. Generally, the t-values and R^2 tended to be higher for the national models than for the Wa area models.

In terms of the statistical significance of the coefficients and explanatory power, equation (5) is singled out as the best acreage response model for the Wa area. Equation (6) is also the best equation for output for the area. From these two equations, it can be inferred that if the price of cotton changes by ten pesewas (¢0.10), ceteris paribus. we can expect seeded cotton acreage to change by 24 acres and output to change by 15,975 lbs. The price elasticity of acreage and output are 0.89 and 1.06, respectively. These figures indicate that a ten percent change in price will bring about

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[1]Brandow, G. E., "A Note on the Nerlove Estimate of Supply Elasticity," Journal of Farm Economics, Vol. XL, August 1958, pp. 719-722.

[2]Griliches, Zvi, "The Demand for Fertilizer: An Economic Interpretation of a Technical Change", Journal of Farm Economics, Vol. XL, August 1958, pp. 591-606.

8.9 percent and 10.6 percent changes in acreage and output, respectively. These figures imply that for the Wa area cotton farmers are more likely to make adjustments in output, to a greater extent, than in acreage, for a given price change.

As far as changes in the price of guinea corn are concerned, equation (5) indicates that a ten pesewa change in the price of guinea corn is likely, ceteris paribus, to lead to an acreage adjustment in cotton production of 96 acres. The corresponding adjustment in output indicated by equation (6) is 2,415 lbs. All these changes are in the reverse direction to the price changes. These figures simply imply acreage and output elasticities of 0.46 and 0.56, respectively.

Similarly, the best national acreage response model is equation (15), whereas the best national output model is equation (19). The former equation indicates that a ten pesewa change in the price of cotton, ceteris paribus, will lead to a change of 124 acres in the national area under cotton, whereas the latter equation indicates the change in seed cotton output will be about 48,500 lbs. These figures imply price elasticity of acreage and of output of 1.04 and 0.86, respectively.

The results of the statistical analysis, therefore, indicate that changes in cotton prices, guinea corn prices and technology, and to a lesser extent urban wage, are the main determinants of cotton acreage and cotton output, both in the Wa area and for Ghana as a whole. Farm size and climatic factors do not appear to have influenced the dependent variables in any significant way for the period covered. On the basis of the magnitudes of the standarized coefficients, the most important variables are price of cotton, technology, and price of guinea corn in that order.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS BASED ON THE FINDINGS

Conclusions and Recommendations

The socio-economic survey identified credit to be a major bottleneck in the Wa area. As much as 85 percent of the farmers interviewed relied on personal savings as a source of finance for their farm operations, while the rest either borrowed money from friends and relatives, for this purpose, or from moneylenders. Even though the Cotton Development Board (CDB) provides inputs such as seeds, fertilizers, insecticides and sprayers free to farmers, finance is still required in other areas such as land clearing and land preparation, weeding and harvesting.

Labor was also identified as a constraint. Not only was it expensive, but there were problems of recruitment due to shortage of supply.

Risk aversion was significantly demonstrated by the Wa farmers. In a world of uncertainty, the desire for security leads them to diversify their crop mixtures in various ways, and perhaps even to ration capital as evidenced by the fact that some farmers were not even prepared to borrow money. Since risk aversion plays an important role in their production decision-making, they are likely to move away from risky alternatives, unless the unexpected return more than compensates for the risk involved.

Of the variables used in the regression study, the price of cotton, the price of guinea corn and trend were found to be the most important variables generating changes in cotton acreage and cotton output. The effects of the urban wage and the consumer price index were weak, whereas the other variables exerted practically no influence.

The results of the study clearly indicate Ghanaian cotton farmers responsiveness to price changes. In this case, cotton and guinea corn prices. This means that prices can be used as policy variables for influencing cotton production. Increasing cotton prices relative to the prices of competing commodities will elicit a greater cotton crop all other factors remaining unchanged. An added incentive to production is when this price is guaranteed. In this connection the CDB's guaranteed minimum price is a step in the right direction. However, there is the tendency for the guaranteed price to be uncertain while other prices, such as guinea corn are leaping upwards. This may have put the brakes on cotton production. There is, therefore, the need to watch other prices and make commensurate adjustments in the guaranteed price for cotton.

The results also indicate that the time trend variable is an important variable which may be responsible for the present level of cotton production. As already indicated, the time trend variable is used as a proxy for technological progress and modernization. Since most of the cotton farmers are illiterate, technological progress and modernization must have come to them substantially through the extension officers of the Cotton Development Board, who as revealed in the study, even live among the farmers in their own villages. It can, therefore, be concluded that the government's efforts at increased cotton production through the provision of free inputs and extension services have been very successful. This should, therefore, be intensified and extended to other areas to bring about further increases in cotton production. There is, however, the need to augment the number of extension officers and facilities available for successful discharge of their functions.

The question of lack of institutional credit must also be addressed by the CDB through attempts to integrate credit and marketing and the provision

of extension services. Farm labor shortage is an intractable problem all over Ghana. It is involved in the whole question of government wage and rural development policies and programs and needs to be given a careful consideration by the government.

Limitation of the Study

A major limitation of this study is the unavailability of data stretching over a long period of time to enable the drawing up of conclusions based on a long-time base. Only a nine-year observation period was possible because commercial cotton production did not start until 1968, and is, therefore, a relatively new industry. As a result, data were available only for the period 1969-1977. The lack of a large number of observations led to a considerable lowering of the number of available degrees of freedom. This reduced the strength of the tests, leading to a greater chance of rejecting as insignificant, variables which otherwise would have been important in determining cotton production. This calls for a similar study at a future date after enough time has been allowed to elapse and the length of the time series has increased.

It would be useful to disaggregate the national model by specifying and estimating acreage supply response equations for other cotton growing areas. It would be useful in these models to find a suitable variable to measure the effect of risk aversion on cotton production.

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APPENDICES

APPENDIX I

MATRIX OF CORRELATION COEFFICIENTS AMONG VARIABLES USED: GHANA

	A	O	PC	PG	UW	FS	T	LA	LO
Acreage (A)	1.000								
Output (O)	0.951	1.000							
Price of Cotton (PC)	0.923	0.987	1.000						
Price of Guinea Corn (PG)	0.654	0.827	0.789	1.000					
Urban Wage (UW)	0.951	0.877	0.833	0.639	1.000				
Farm Size (FS)	0.699	0.701	0.628	0.663	0.658	1.000			
Trend (T)	0.843	0.895	0.816	0.901	0.842	0.787	1.000		
Lagged Acreage (LA)	0.951	0.852	0.791	0.593	0.971	0.753	0.851	1.000	
Lagged Output (LO)	0.967	0.864	0.861	0.573	0.977	0.721	0.978	0.996	1.000

APPENDIX II

MATRIX OF CORRELATION COEFFICIENTS AMONG VARIABLES USED IN THE REGRESSION ANALYSIS - WA AREA

	A	O	PC	PG	UW	FS	T	LA	LO
Acreage (A)	1.000								
Output (O)	0.958	1.000							
Price of Cotton (PC)	0.864	0.963	1.000						
Price of Guinea Corn (PG)	0.579	0.726	0.789	1.000					
Urban Wage (UW)	0.482	0.483	0.385	0.650	1.000				
Farm Size (FS)	0.654	0.621	0.628	0.663	0.529	1.000			
Trend (T)	0.815	0.847	0.816	0.901	0.756	0.492	1.000		
Lagged Acreage (LA)	0.873	0.767	0.658	0.576	0.644	0.838	0.864	1.000	
Lagged Output (LO)	0.963	0.860	0.744	0.479	0.480	0.733	0.784	0.949	1.000