A STUDY OF THE COTTON SUBSECTOR IN BURKINA FASO

By

Sogossi K. Traore

A PLAN "B" RESEARCH PAPER

Submitted to
Michigan State University
In partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Agricultural Economics

1984

Table of Contents

List of Tables

List of Figures

Acknowledgements

I wish to express my sincere and warmest gratitude to Dr. John M. Staatz, my major Academic Advisor, for his stimulating, patient guidance, constructive criticisms, and availability to assist me during the production of this paper; Dr. Manderscheid, my former Advisor; and Dr. Harsh for their dedication to my work while they served as members of my guidance committee.

Many, many thanks to the Graduate Students in my Department and friends I met here at Michigan State University for their moral support. Special thanks to Hebie Sekou, Sanou Saïdou, Bonkian Adama, Diendere Pamateba H., P. Bonnard, and C. Brooks.

Particular thanks to A natole K. Yameogo and Soumana Traore, to whom I am indebted and deeply respect for their advice, readiness to help, and their persistent encouragement.

Finally, but not least, my heartfelt thanks to my loving wife, Maroufatou Traore, for her patience during my absence, to my brothers and sisters and family at large for their prayers and good wishes.

It is during such moments that I pause and reflect about my late Mom, Dad, Grandmother, and beloved sister. May God rest their souls in peace.

To My Wife

Chapter I

Introduction

1.1 Background

Burkina Faso is a landlocked country of the Sahel, bordered on the south by the Ivory Coast, Ghana, Togo and Benin, on the east by Niger, and on the northwest by Mali. The surface is a plain, lying between 250 and 350 m above sea level and inclined slightly toward the south. The country covers some 274,000 km^2, of which about 33 percent is considered arable. Its principal outlet to the sea is Abidjan, in the Ivory Coast, to which it is linked by railroad, road and air.

The climate of Burkina is primarily sudanian. The country also falls into the zone known as semi-arid tropics, characterized by a net moisture deficit for more than half the year and by temporal variability in rainfall patterns. The dry season can be divided into two periods: a relatively cool period for three months following the end of the rains (December to February), and a much hotter period prior to the beginning of the rains.

Rainfall throughout the country is low and occurs over a short period. In general, the rain begins slowly in May, reaches its peak in August, and falls off sharply in October. For agriculture, it is important that the distribution of rainfall is not concentrated too much in the mid-months of the rainy season.

The country lacks mineral resources that can be exploited profitably with present technology. Burkina economic progress depends primarily on the performance of its agricultural sector, which employs 80-90 percent of the population. Crop cultivation is still the dominant activity in agriculture. It contributed about a fourth of Gross Domestic Product (GDP)

during the 1970's. Farmers' efforts in most parts of the country are hampered by poor soils and irregular rainfall.

In the northern, central and eastern regions of the country, unfavorable factors, such as eroded and overexploited soils, absence of year-round flowing rivers and low rainfall, keep average agricultural production at low levels. In contrast, in the west and the southwest, climatic and pedologic conditions are much more favorable, and agriculture here is more diversified, permitting the accumulation of marketable surpluses. The main crops cultivated in Burkina are sorghum, millet, maize, groundnuts, yams, and cotton.

1.2 Need for the Study

Cotton is the main export crop and a growing source of farmer income. In Burkina Faso, cotton represented some 40 percent of the total recorded exports in recent years (Table 1.1). During the same period, about 50 percent of agricultural exports were comprised of cotton.

Each year, SOFITEX, the Burkina cotton company (a government cotton parastatal) purchases about 3-4 billion CFAF worth of cotton from farmers.[1] A large amount of this money goes to farmers in two ORDs, Hauts Bassins and Volta Noire.[2]

The promotion of cotton cultivation in the country has led to an expansion of SOFITEX, i.e., the creation of new ginneries. In addition, the increased level of cotton seed provided by SOFITEX has allowed the parastatal in charge of oil and soap production, the Société des Huileries et des Savonneries du Burkina Faso (SHSBF) to operate at full capacity. Expanded cotton production has also indirectly stimulated expanded production at the Attelier Regional de Construction de Matériaux Agricoles (ARCOMA)

Table 1.1 The Value of the Total Exports and Cotton Exports Burkina Faso (1974-1982)

Unit: Million CFAF

Year	Total Value of Burkina Exports	Total Value of Cotton Exports	% of Cotton in Total Exports	Total Value of Agricultural Exports	% of Cotton in Total Agricultural Exports
1974	8,702	1,827	21	8,210	22
1975	9,368	1,593	17	8,817	12
1976	12,690	5,837	46	11,615	50
1977	13,614	5,446	40	12,722	43
1978	9,600	3,072	32	8,829	35
1979	16,238	5,683	35	13,698	41
1980	19,066	8,389	44	16,508	51
1981	19,919	8,167	41	17,106	48
1982	18,110	7,602	42	15,500	49

Source: BCEAO (Banque Centrale des Etats de l'Afrique de l'Ouest). Annual Reports for 1975 and 1983. Dakar.

and Volta Textiles (VOLTEX). The SHSBF, ARCOMA and VOLTEX are all parastatals, which employ significant numbers of owrkers.

Cotton taxes provide substantial revenues to the government. These cotton revenues to the government arise from three separate sources:

1. A cotton levy of CFAF 4500/ton of seed cotton paid into the development fund, for cotton and other types of development as well;
2. Export taxes of CFAF 1000/ton of seed cotton equivalent;
3. A payment by SOFITEX to the ORDs equal to 10 percent of SOFITEX's profit greater than 7.5 percent of turnover.

These taxes result in a transfer of income from the cotton subsector to other sectors via the government which allows these sectors to participate actively in the development of the economy as well. During the past 20 years, the cotton subsector has become one of the key elements in the national economy. The subsector, however, is facing some crucial policy issues.

The two policy issues to be dealt with specifically in this paper are: 1) government price controls on seed cotton; and, 2) government subsidies on inputs. Historical data indicate that nominal cotton prices have often remained constant for three or four years at a time because of government intervention. The low producer prices set by the government each year may discourage farmers from producing cotton, leading them instead to expand production of sorghum and millet which are substitutes in production for cotton in Burkina.

Input prices have been subsidized by SOFITEX since 1971 in order to stimulate the use of fertilizer and insecticides by farmers. This policy has led to a tremendous increase in consumption of inputs, consequently

increasing cotton yields. Now, under World Bank pressure, the government has decided to remove these subsidies gradually. What will the impact of such a decision be on farmers' behavior?

1.3 Objectives of this Study

In Burkina, no study of the cotton subsector has ever been done. There is, however, some basic information related to cotton acreage, yields, production, prices of output and inputs, all of which are relevant for decision-making. Time series data for a long period are not available at the ORD level. In view of the prominent position of cotton in the Burkina economy, the expansion of cotton production has become an important agricultural policy issue. Therefore, studies are needed concerning the major determinants of the supply of cotton in the country. The general objective of this study is to examine the cotton subsector. The specific objectives are:

a) To describe the cotton subsector in Burkina Faso.

b) Based on a subsector analysis, to develop an economic model of factors influencing cotton supply.

c) To develop and test a statistical model built on the economic model.

d) To use the statistical results to analyze the two policy issues mentioned above and to evaluate alternative policies for the subsector.

1.4 Methodology

The first specific objective is accomplished by using the information obtained from diverse sources, including personal observations made during the author's stay in Hauts Bassins ORD from 1979-1982. During this period,

he worked with farmers and the SOFITEX staff. The contact with farmers and SOFITEX staff provided him with some understanding of the cotton subsector. He was involved in the marketing process; his responsibility was to supervise the different buying spots and coordinate the activities between SOFITEX and the ORD. He used some information from Bloud and Henry. These two authors had written about cotton in West Africa during the colonial period.

The second objective which involves the development of a supply response model, is achieved by developing an economic model. The third objective is accomplished by testing the parameters of the supply response equations estimated using time series data obtained from SOFITEX annual reports and other secondary sources. Finally, the fourth specific objective is accomplished by using the results to simulate what would occur if various policies were carried out, such as removal of input subsidies.

1.5 Data Collection

Data used in this study have been adopted from the FAO Production Yearbook, SOFITEX annual reports and reports from the Hauts Bassins ORD. Data from SOFITEX and the ORD were collected by extension agents through interviews with farmers. In addition, the extension agents were supervised by sector, extension service and production service chiefs, suggesting that these data are reliable. Data from the FAO Production Yearbook were obtained by FAO officials from the Ministry of Agriculture and Livestock. The consumer price index and the export values are from BCEAO. These data were given to BCEAO by the Ministries of Finance and Trade.

1.6 Plan of the Study

This paper is organized first to provide in Chapter II the necessary background about the cotton subsector in Burkina Faso. A theoretical cotton supply model is then developed in Chapter III. The statistical results obtained in Chapter III are used in Chapter IV where the policy analysis is developed. Finally, Chapter V includes a summary and the conclusions of the study.

Footnotes

1. See the list of abbreviations at the end of this paper.

2. The ORD is the Regional Development Office corresponding to the Department which is an administrative division of the country. There are 11 ORDs in Burkina Faso. One ORD is an agency of the Ministry of Agriculture and Livestock. They have the responsibility to promote agricultural and animal production.

Chapter II

Description of the Cotton Subsector

2.1 Cotton Development in Burkina Faso

Cotton has been grown in Burkina Faso for a long time, beginning before the colonial period. Traditionally, mixed cropping was practiced. Farmers used to grow cotton with maize or another food crop. In each village, spinning by women and weaving by men had developed. Almost all cloth was made with cotton, and merchants traded cloth from village to village.

Under the colonial administration, the mode of production took another form. The native Burkinabe were obliged to grow cotton in order to satisfy the French Colonial administration's needs. The French government implemented the same policy in all its colonies where conditions were propitious. During this period, European colonial growers envied the U.S.A., which was playing an important role in the world cotton market.

In 1911, under French domination, the western part of Burkina (Bobo-Dioulasso and Dedougou) was explored by M. Level, an agent of the Association Cotonnière Coloniale (A.C.C.). This report influenced M. Waddington, president of the association. In January 1924, Waddington personally conducted a survey in the same regions and also concluded that these regions were fertile and therefore cotton cultivation could be developed.

With the combined efforts of the colonial administration and local chiefs, a propaganda campaign was launched. It was the duty of each chief to grow a field of cotton. These cotton fields were called "the Commanding Officer's field," or "the collective field." In each village,

villagers were supposed to grow cotton so that they could bring their production to market. The product was sold at a low price to the colonial administration which exported it to different international cotton markets.

The American cotton success evoked jealousy among many industrialized countries. The French government was eager to produce more cotton in its colonies. To accomplish this goal, the French sent people to the U.S.A. to gain experience in cotton production so that they could transfer the acquired knowledge to their colonies. In addition, the French colonial authorities sought to apply two different models of cotton development: the German model and the American model.

The German model, or school farm, consisted of choosing some young peasants and training them for a period of three years. After their training, these students were supposed to set a good example for the other peasants. The American model, or school village, consisted of founding new villages where young farmers were settled and provided with equipment for cotton cultivation. These farmers were supposed to be married or steps were taken to get them spouses. In addition to cotton cultivation, the farmers were allowed to grow food crops. Other considerations included in the design of the village were provisions of markets and the settlement of the village near principal roads and water.

Both these models were tested, but neither worked because the participating farmers remained attached to their previous social and cultural groups. As a result, cotton production grew only slowly. After these failures, the colonial power changed its approach. ACC became La Compagnie Française pour le Développement des Fibres Textiles (CFDT), and sent technicians known as CFDT agents to rural villages. These extension

agents' sole responsibility was to teach farmers how to grow cotton. Later, they were replaced by native extension agents who undertook the same activities. Some former CFDT agents became ORD Director advisors.

Since the independence of Burkina Faso, many farmers have become involved in cotton cultivation, and the acreage devoted to cotton has increased, leading to an increase in production. Yields, however, remained low for many years. The CFDT extension approach, higher cotton prices relative to production costs, and a well-organized cotton marketing system had contributed to the adoption of cotton cultivation by new farmers. This increase induced CFDT in 1972 to look for sources to finance the country's first large cotton project (the projet coton). Figure 2.1 indicates where that project was implemented. It covered the Hauts Bassins and Volta Boire ORDs. After 1972, 53 percent of total acreage and 77 percent of national production has been within the project area. That project ended in 1976. It led to such encouraging results that the World Bank financed the "Projet de Dévéloppement Agricole Ouest Volta I" (PDAOVI). The new project included many objectives, including an increase in cotton production, an increase in food crop production, and the introduction of a training and visit extension system. (The training and visit system is an extension approach that allows farmers to get more contact with the extension agents.) As part of the project, a certain number of farmers were visited weekly. During these visits, extension agents provided advice to farmers and received feedback from them. This five-year project has also been successful in extending the work of the preceding cotton project to stimulate more general agricultural development in the area.

Table 2.1 illustrates the evolution of cotton production and average yields from 1972 to 1981 for the two ORDs where these projects have been implemented. From 1972 to 1981, there has been an increase of

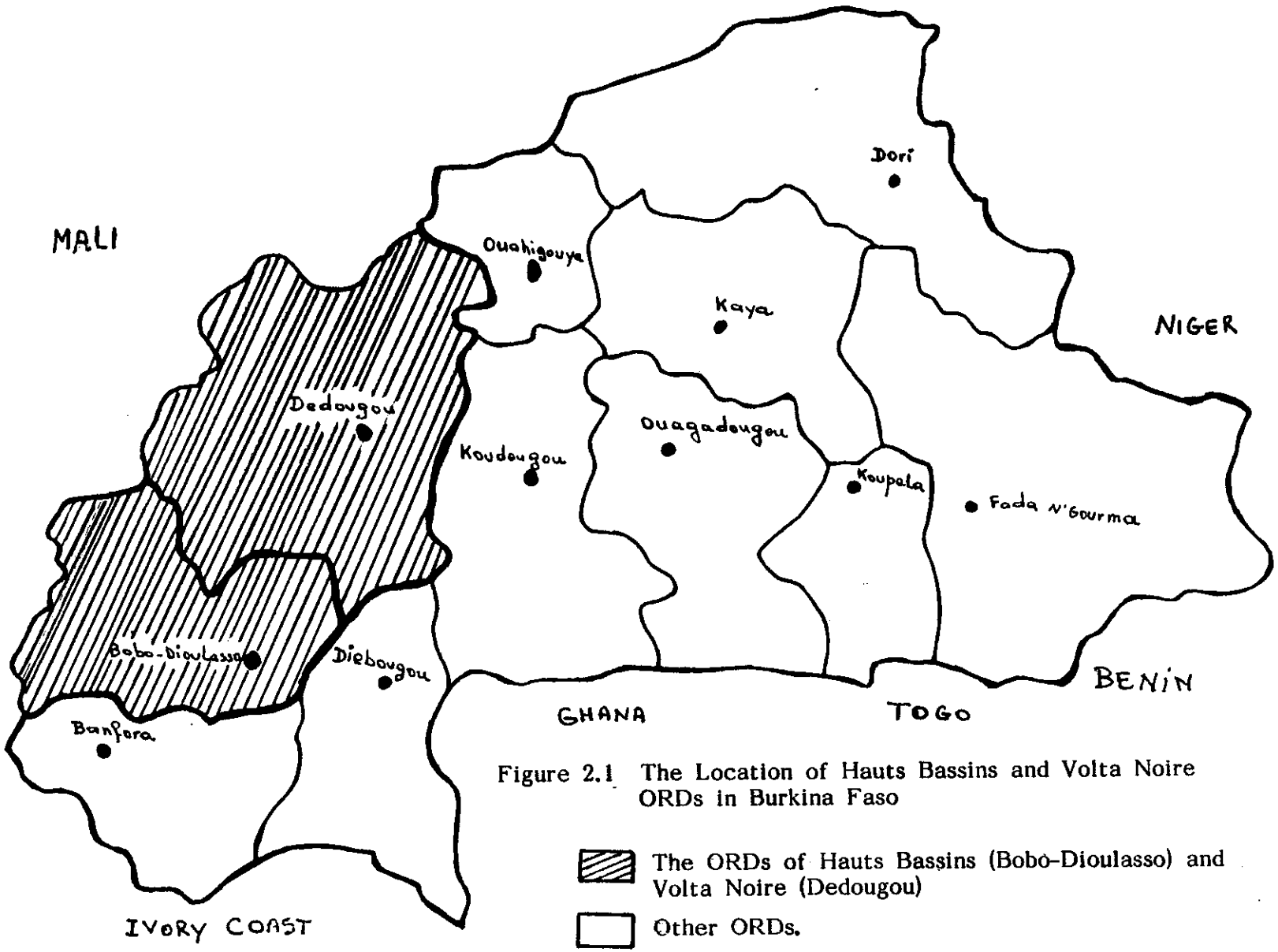


Figure 2.1 The Location of Hauts Bassins and Volta Noire ORDs in Burkina Faso

Source: Salace (SOFITEX OuagadougouOffice). 1984.

Table 2.1 Evolution of Cotton Production and Yield under Projects in Hauts Bassins and Volta Noire ORDs.

	"Projet Coton" Cotton Project Period						PDAOV #1 Western Volta Agricultural Development Project - I				
Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
National Production (T)	28,126	32,574	26,668	30,562	50,634	55,253	38,043	59,956	77,520	62,539	57,534
Haut Bassins ORD Production (T)	8,200	10,024	9,469	12,627	20,681	21,896	16,738	23,753	29,813	25,533	25,775
% of National Production	29	32	41	41	40	40	44	40	38	40	45
Yield kg/ha	756	847	889	1028	967	866	1,182	1,182	1,174	1,204	1,275
Volta Noire ORD Production (T)	13,684	14,960	10,988	13,289	24,095	24,551	15,844	26,470	35,076	27,876	22,247
% of National Production	49	46	41	43	48	44	42	44	45	45	39
Yield Kg/ha	488	493	374	535	1,008	571	578	822	982	706	791

Source: Adopted from Hauts Bassins ORD, unpublished document. Bobo-Dioulasso. 1984.

51 percent in yield and 157 percent in production in the Hauts Bassins ORD. In the Volta Noire ORD, the yield has increased by 62 percent and production by 49 percent.

The most recent project in the same regions started in 1982. Increase in cotton production is one of its main targets among its multiple objectives. Two other ORDs (Bougouriba and Koudougou) are expanding their production. Two agricultural projects have been financed in these two ORDs recently.

2.2 Cotton Cultivation

As discussed above, cotton is not a new crop for farmers in Burkina. Its cultivation is more important in the western part of the country where land is available and where pedological and climatological conditions are better. Cotton is produced by smallholders who use hand tools, animal traction or small tractors (Bouyer). The cultivation of cotton has become a tradition for these farmers. They practice crop rotation (cotton-sorghum-millet). This cultural method allows an increase in sorghum or millet yield. The farmers can use their lands efficiently. Special equipment such as sprayers, sowing machines are also used by cotton growers. Cotton cultivation is demanding, requiring intensive labor use. These requirements involve the use of labor in preparing land, seeding, weeding, ridging, spraying, and harvesting. Most of the labor is provided by the family, which frequently numbers between seven and ten members. In some cases, particularly in the harvest period, some families hire labor. The wages vary among regions and even within the region.

Formerly, cotton was grown in association with other crops. This method tended to be abandoned by farmers because of the recent introduction

of insecticides and herbicides recommended for cotton only. Monocropping seems to be the new approach; even the shifting cultivation method is practiced less by farmers.

Cotton is planted in June, and harvested and marketed from November to April. After cotton has been harvested, land is prepared for the next crop, which is often sorghum. Table 2.2 indicates that, in 1969, a record 84,076 hectares were planted to cotton. Production totaled only 36,248 tons of seed cotton, however, because of a low yield of only 431 kg/ha. By 1979, production had risen to 77,520 tons, representing a 114 percent increase of production in ten years. In 1979, the average yield was 945 kg/ha, or a 119 percent increase over 1969 levels. In 1982, the national average yield was 1,050 kg/ha, whereas it was only 183 kg/ha in 1962 and 465 kg/ha in 1972.

Looking at the regional distribution of production of cotton, three ORDs produce the greatest amount: Hauts Bassins (Bobo Dioulasso), Volta Noire (Dedougou) and Bougouriba (Diebougou). Table 2.3 shows the share of acreage and production for the Bougouriba, Hauts Bassins and Volta Noire ORDs for the period 1970-1981. Bougouriba ORD had 4.9 to 10.2 percent of total national acreage and 4.7 to 7.3 percent of national production. The major proportion of both production and acreage belongs to Hauts Bassins and Volta Noire. These two ORDs had 44 to 71 percent of total acreage and 70 to 84 percent of national production throughout the period.

Table 2.4 illustrates the evolution of yield by region between 1970 and 1981. The increase in yields is more significant in the two leading ORDs than the others. As stated before, this regoinal pattern of cotton production is because of the investments made in these regions and to more

Table 2.2 Evolution of Cotton Production in Burkina Faso (1961-1982)

Year	Area (1000 ha)	Seed Cotton (1000 kg)	Yield kg/ha
1961	22.9	2,341	113
1962	36.0	6,600	183
1963	45.8	8,048	186
1964	52.5	8,769	170
1965	49.7	7,463	137
1966	52.4	16,297	311
1967	65.4	17,275	264
1968	71.6	32,027	447
1969	84.1	36,248	431
1970	80.5	23,484	291
1971	74.0	28,126	379
1972	70.0	32,574	465
1973	66.6	26,669	413
1974	61.5	30,695	497
1975	68.0	50,695	745
1976	79.2	55,254	697
1977	68.7	38,043	553
1978	71.7	59,955	837
1979	82.0	77,520	945
1980	74.9	62,539	834
1981	65.2	57,534	882
1982	71.9	75,572	1,050

Source: SOFITEX annual reports (1978-1982). Ouagadougou.

favorable soil and climatic conditions. The introduction and the acceptance by farmers of innovations such as the use of animal tractors, fertilizers, insecticides, and herbicides seem to be the major reasons for the yield increases. Effective extension efforts have played a key role in bringing about these innovations. Moreover, the introduction of the training and visit system in Hauts Bassins and Volta Noire ORDs has freed the extension agents from other activities such as distribution of inputs and credit, allowing them to concentrate on extension activities. (The distribution of inputs and credit will be discussed later in this chapter.)

Continuous training of extension agents and the existence of incentives for the agents, such as the annual premiums, allowances and facilities to buy motorcycles, have motivated these people to work hard with the farmers so that they could improve their production. The high yield of Hauts Bassins and Volta Noire ORDs have greatly enhanced the national average yield in recent years, as shown in Table 2.4.

Over the last 21 years, there has been tremendous variability in both acreage and yields. Table 2.5 shows that variability. In the Burkina case, where nominal prices often have been constant for three or four years in a row, real prices have been eroded by inflation and this may have affected farmers' planting decisions.

The area planted to cotton represents only 2-3 percent of total area covered by the major crops cultivated in the country. Table 2.6 indicates the evolution of the total area under cultivation, the cotton area and the share of cotton acreage in the total from 1961 to 1981.

2.3 Institutions Involved in Cotton Production

In Burkina, many institutions are involved in cotton production. They promote cotton cultivation. The Institut de Recherches du Coton et des

Table 2.3 Evolution of Cotton Cultivation in Hauts Bassins, Volta Noire and Bougouriba ORDs
(1970-1981)

Years	Share of Total Area in the Whole Country %		Share of Total Production in the Whole Country %	
	Bougouriba ORD	Hauts Bassins and Volta Noire ORDs	Bougouriba ORD	Hauts Bassins and Volta Noire ORDs
1970	4.9	43.6	4.7	70.1
1971	5.5	47.5	5.0	77.9
1972	5.2	53.2	4.9	76.6
1973	7.5	55.4	5.6	76.6
1974	6.5	59.2	3.5	84.6
1975	7.1	64.7	3.6	88.3
1976	8.9	76.3	4.5	83.0
1977	10.5	65.6	4.7	85.8
1978	8.1	69.6	5.7	83.1
1979	9.0	77.4	6.2	86.4
1980	9.0	70.0	6.5	85.4
1981	10.2	71.2	7.3	83.7

Source: World Bank. Projet Engrais. Document de travail No. 2. "Impact du projet sur la production cotonnière." 12 Octobre 1983. Ouagadougou.

Table 2.4. Evolution of Yield in Hauts Bassins and Volta Noire, Bougouriba and the other ORDs, and the National Average Yield. (1970-1981)

Years	Bougouriba ORD kg/ha	ORDs Other than Bougouriba, Hauts Bassins kg/ha	Hauts Bassins & Volta Noire ORDs kg/ha	National Average Yield in kg/ha
1970	281	142	469	291
1971	345	138	622	379
1972	438	207	670	465
1973	301	192	554	413
1974	266	172	712	497
1975	378	214	1,018	745
1976	354	541	769	697
1977	249	219	722	553
1978	568	408	1,002	837
1979	665	525	1,078	945
1980	592	295	955	834
1981	629	426	1,033	882

Source: World Bank Projet Engrais. Document de travail No. 2. "Impact du projet sur la production cotonnière." 12 Octobre, 1983. Ouagadougou.

Table 2.5 Evolution of Cotton Acreage Yields (1961-1981).

Year	Area (1000 ha)	% Change	Yield kg/ha	% Change
1961	22.9	---	113	-----
1962	36.0	57	183	62
1963	45.8	27	186	2
1964	52.5	15	170	-9
1965	49.7	-5	137	-19
1966	52.3	5	311	127
1967	65.4	25	264	-15
1968	71.6	10	447	69
1969	84.1	17	431	-4
1970	80.5	-4	291	-32
1971	74.0	-8	379	30
1972	70.0	-5	465	23
1973	66.6	-5	413	-11
1974	61.5	-8	497	20
1975	68.0	11	745	50
1976	79.2	17	697	-6
1977	68.7	-13	553	-21
1978	71.7	4	837	51
1979	82.0	14	945	13
1980	74.9	-9	834	-12
1981	65.2	-13	882	6

Source: Calculated from data in SOFITEX Annual Report, 1982. Ouagadougou.

Textiles Exotiques (IRCT), the extension service, the organizations of rural people, and SOFITEX are these institutions, which act separately or interact between themselves for a better coordination.

2.3.1 IRCT

This French institute does field work related to cotton diseases, fertilizer, treatment trials, and mass selection. IRCT operates the Boni farm, located in the Hauts Bassins ORD and has trials around the country. In collaboration with extension agents, these trials are implemented in farmers' fields. Any new variety introduced is tested by IRCT. IRCT's active cotton program has resulted in a promising new variety, L299-20-75, with a fiber productivity superior to MK 73, which has replaced BJA, previously the most widely cultivated variety. The technical support from the ORDs, IRCT and SOFITEX contributed to the increase in cotton production discussed earlier.

2.3.2 The Extension Agents

The extension services are under the authority of the Ministry of Agriculture and Livestock. These services are decentralized so each ORD has its own extension service. The extension agents receive their training at the Matourkou Agriculture School. In addition to these agents, there is another category of extension agents who are engaged by contract and who spend nine months at Matourkou, whereas the other agents get a degree after three or four years at the same school.

The number of extension agents varies from one ORD to another. In the ORD where projects have been financed, the number of the agents and the effectiveness of these extension agents are significant. The cotton ORDs, such as Hauts Bassins and Volta Noire, seem to have the best organized

Table 2.6 Evolution of Acreage Under Cultivation for Major Crops* and the Share of Cotton

Year	Total Area Under Cultivation (1,000 ha)	Cotton Area (1,000 ha)	Share of Cotton %
1961	1,994.9	22.9	1.2
1962	2,194.0	36.0	1.6
1963	2,090.8	45.8	2.2
1964	2,391.5	52.5	2.2
1965	2,167.7	49.7	2.3
1966	2,231.4	52.4	2.4
1967	2,505.4	65.4	2.6
1968	1,958.6	71.6	3.7
1969	2,344.1	84.1	3.6
1970	2,262.6	80.6	3.6
1971	2,112.1	74.1	3.5
1972	2,084.1	70.1	3.4
1973	2,153.6	66.6	3.1
1974	2,391.5	61.5	2.6
1975	2,470.0	68.0	2.8
1976	2,467.2	79.2	3.2
1977	2,305.8	68.8	3.0
1978	2,481.7	71.7	3.0
1979	2,201.7	82.0	3.7
1980	2,074.9	74.9	3.6
1981	2,515.2	65.2	2.6

Source: Calculated from data in "Rapport Mission Conjointe Banque Mondiale/FAO/ISNAR sur la Recherche Agronomique en Haute Volta," 1983, Ouagadougou.

*Major crops include sorghum, maize, millet, rice, groundnuts, sesame, and cotton.

extension program, which promotes improved cultivation techniques and the use of fertilizers and insecticides. Now attention is also being paid to food crops. It is hard to evaluate the impact of the extension agents, but it is clear that they did benefit farmers. The extension agents assist farmers in adopting improved production practices, provide feedback and interaction between peasants and the researchers, and promote the delivery of information and services, as well as increase farmers' ability to pursue their own communal interests (collective fields, schools and dispensaries).

2.3.3 The Organization of Rural People

The "Direction des Institutions Rurales" (DIR) which is a division of the Ministry of Agriculture and Livestock, has the full responsibility to organize rural people. In each ORD, the DIR is represented by the Community Development Service.

Burkina, like other developing countries, has experimented with the community development movement and integrated rural development. Now, decision-makers are talking about village groups. These groups are fairly similar to those promoted by the community development movement in its endeavor to bring prople together for common enterprises. People are encouraged to organize themselves into village groups (VG) or informal cooperatives which receive advice from extension agents. These village groups are supposed to accomplish certain tasks formerly handled by the extension service, such as distribution of inputs and credit, and managing local markets. The number of village groups is growing in each ORD. In the sections below covering input distribution and credit, the roles of these village groups will be detailed.

2.3.4 Credit

Prior to the establishment of the "Caisse Nationale de Crêdit Agricole" (CNCA), formal agricultural credit activities in Burkina were characterized by weak, decentralized administration, and poor repayment rates. Authorized by the Presidential Decree of August 14, 1979, the CNCA was set up on August 21, 1980. A convention exists between CNCA and the ORDs delineating the responsibilities of each party concerning agricultural credit to be extended. With the creation of the CNCA, a credit bureau was established in each ORD.

There are two kinds of farm credit: short-term and medium term. Short-term credit covers operating costs, such as fertilizer and insecticides. SOFITEX is the procurer of NPK fertilizer for the entire country; it also imports urea and insecticides. Prior to 1978, SOFITEX provided fertilizer and insecticides on credit to all ORDs, which either sold them for cash or, in the case of cotton ORDs, provided them on seasonal credit to farmers. Under the current system, SOFITEX extends short-term seasonal credit to cotton ORDs for inputs, including fertilizer used on cereals and other special crops. The ORDs in turn can sell the fertilizer for cash to individuals or provide it on credit to village groups. Medium-term credit is for equipment such as oxen and plows. That credit is financed by CNCA. Even though CNCA loans are extended to the village groups on the basis of the expected repayment capacity of individual members, if the individuals fail to repay the loan, the group as a whole is liable for the debt.

2.3.5 Distribution of Inputs

Once ORDs have estimated the quantities of seeds, fertilizers and insecticides needed, these orders are transmitted to SOFITEX, which then

imports them. The distribution of inputs is handled by SOFITEX and ORDs. SOFITEX transports seed directly to different villages. The ORDs distribute the fertilizer and insecticides in the villages where ORDs have built stores or to the village groups. From these different places, farmers can get the quantity of input they need.

2.3.6 SOFITEX

SOFITEX is a parastatal institution which has the responsibility for promoting cotton cultivation, providing inputs to farmers, buying seed cotton, transporting it to its different ginneries. and selling fiber and seeds. SOFITEX has CFAF 2.2 billion in capital, with ownership divided among several participants.

Table 2.7 Shares of "Capital" Ownership in SOFITEX

Participants	% Share of Capital
Gov't of Burkina Faso	65
CFDT	34
Banque Internationale des Voltas (BIV)	.5
Banque Internationale pour le Commerce, l'Industrie et l'Agriculture (BICIA)	.5
TOTAL	100

Source: SOFITEX unpublished document, Ouagadougou, 1983

SOFITEX currently operates six ginneries in the country. These ginneries have been built taking into account the major production zones and the existence of a textile plant at Koudougou owned by Volta Textile (VOLTEX). The first ginnery was built in Bobo-Dioulasso in 1957, and the most recent was built in 1981. The following is a list of ginneries and their dates of construction in Burkina:

Bobo Dioulasso I in 1957

Ouagadougou in 1958

Koudougou in 1969

Bobo Dioulasso II in 1970

Hounde in 1978

Dedougou in 1981

The capacity of these ginneries varies from 5,000 to 20,000 tons. The following map indicates their locations and their size.

2.4 Government Price Policies

The price of cotton is fixed by the government. It has a monopoly power in the cotton market. SOFITEX can buy seed cotton from farmers at a relatively low price even if the price of this commodity is high in the international market. In other words, the farm gate price has always been below the world price. From the government intervention, SOFITEX can accumulate a huge profit. In Burkina, nominal cotton prices have remained unchanged in some cases for three or four years in a row. Table 2.8a indicates that real cotton prices are falling, whereas there is no exact trend for real sorghum prices. Consequently, in Table 2.8b, the ratio of the cotton price to the sorghum price is falling.

2.5 Marketing Channels

The estimation of production by the ORD officials allows the extension agents to establish a purchasing calendar for all villages where cotton has been grown. Each ORD sends its first draft of the purchasing calendar to SOFITEX, then both SOFITEX and ORD set up a meeting in which they discuss and establish a final buying calendar. Usually, the marketing begins

Table 2.2 Geographic distribution of cotton production and ginneries in Burkina.

Source: Adapted from unpublished document provided by Mr. Salace (SOFITEX, Ouagadougou).

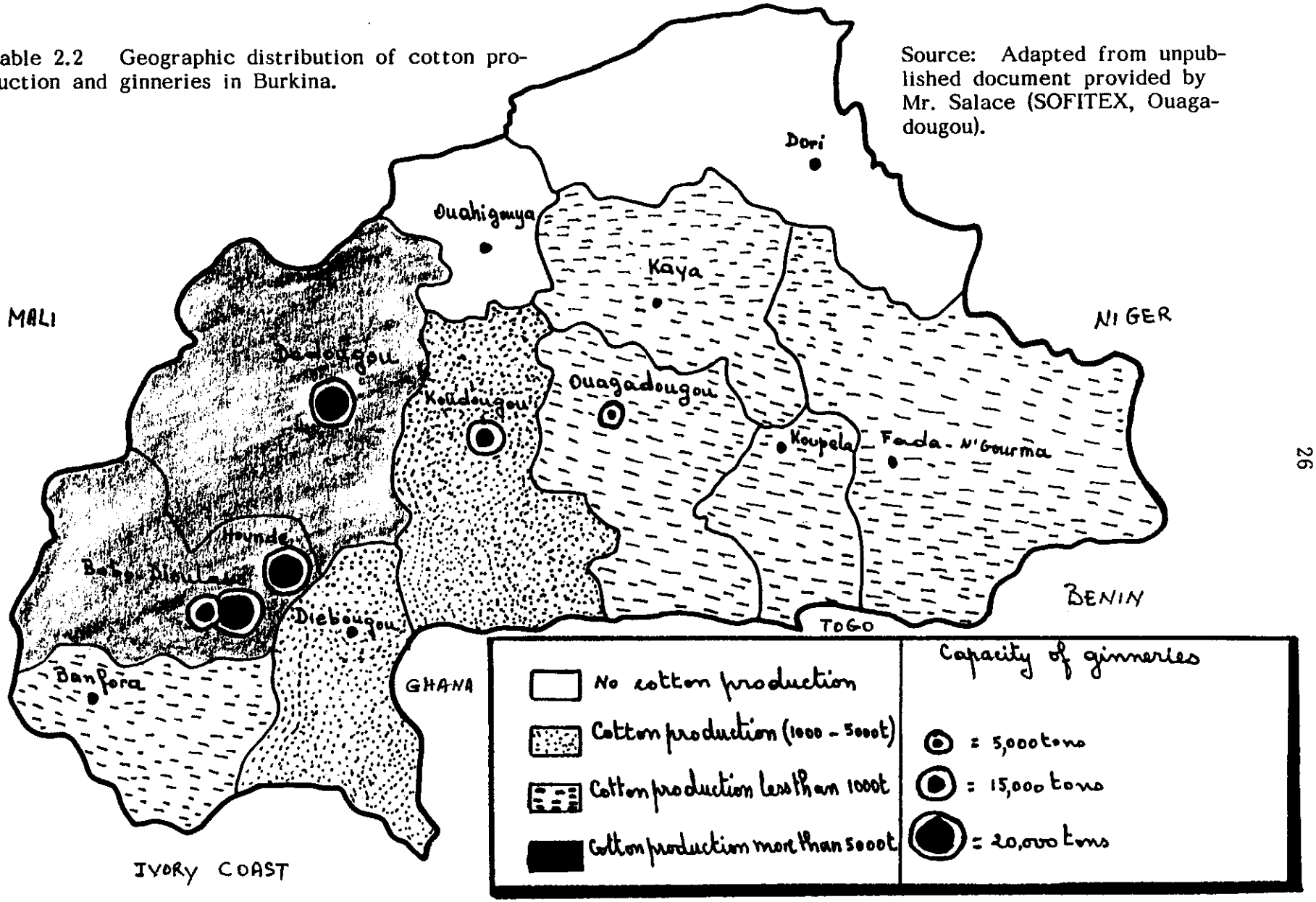


Table 2.8a. Evolution of nominal and real cotton and sorghum prices from 1961 through 1981.

Year	Nominal Cotton Prices		Real Cotton Prices		Nominal Sorghum Prices		Real Sorghum Prices		CPI
	CFAF/kg	% Change from previous yrs	CFAF/kg	% Change from previous yrs	CFAF/kg	% Change from previous yrs	CFAF/kg	% Change from previous yrs	1970 = 100
1961	34	---	38.2	---	12	---	13.5	------	88.8
1962	32	-6	35.6	-6.8	12	0	13.4	-.7	89.8
1963	33	3.1	36.3	2.0	15	25	16.5	23.1	90.8
1964	34	3.1	26.7	1.1	13	-13.3	14.0	-15.2	92.6
1965	24	0	37.0	.8	11	-15.4	11.9	-15	91.8
1966	34	0	36.2	-2.21	13	18.4	13.8	16	93.9
1967	32	-6	35.4	-2.2	14	8	15.5	12.3	90.4
1968	32	0	35.6	.6	12	-14.3	13.4	-14	89.9
1969	32	0	33.0	-7.3	12	0	12.4	-7.5	96.8
1970	32	0	32.0	-3.0	12	0	12.0	-3.2	100
1971	32	0	31.3	-2.2	12	0	11.8	-2	102.1
1972	34	0	32.3	3.2	14	17	14.1	19.5	99.1
1973	35	9.3	32.8	1.6	18	29	16.8	19.1	106.6
1974	40	14.3	34.5	5.2	22	22.2	18.9	12.5	115.9
1975	40	0	29.0	-16	18	-18.1	13.1	-31	137.7
1976	40	0	31.7	9.3	23	28	18.2	40	126.1
1977	55	38	32.8	3.5	32	39.1	19.1	5	167.6
1978	55	0	25.1	-23.5	40	25	18.3	-4.2	218.7
1979	55	0	26.9	7.2	40	0	19.6	7.1	204.1
1980	55	0	24	-11.0	40	0	17.5	-11	229.0
1981	60	9.1	24.4	2.0	45	13	18.3	4.6	246.3

Source: Prepared from data provided by M. Cochelin (Hauts Bassins) 1980, and M. Salace (SOFITEX Office, Ouagadougou) and from CILSS/Club du Sahel, Développement des cultures pluviales en Haute Volta, September 1982, p. 60.

Table 2.8b Evolution of the Ratio of Cotton and Sorghum Prices. (1961-1982)

Year	Cotton Price / Sorghum Price	Year	Cotton Price / Sorghum Price
1961	2.8	1972	2.3
1962	2.6	1973	1.9
1963	2.2	1974	1.8
1964	2.6	1975	2.2
1965	3.1	1976	1.7
1966	2.6	1977	1.7
1967	2.3	1978	1.4
1968	2.6	1979	1.4
1969	2.6	1980	1.4
1970	2.6	1981	1.3
1971	2.6		

Source: Prepared from data provided by M. Cochelin (Hauts Bassins OTD) Bobo Dioulasso, and M. Salace (SOFITEX Office, Ouagadougou), and CILSS/Club du Sahel Développement des cultures pluviales en Haute-Volta. September 1982, p. 60.

in November and ends in April. SOFITEX is a legal monoposomy with respect to buying cotton from farmers. Although in some isolated cases one can find seed cotton in the local market, the private trade has little impact on cotton trade. SOFITEX uses three marketing channels for acquiring cotton.

First, there is the "classical team." The members of this team are selected extension agents who buy cotton in the villages. Farmers receive cash for their cotton, but at the same time, they have to pay back their short-term and medium-term credit to the extension agent. Once the cotton is bought, it is stored in the village, and its transportation to the ginneries is assured via SOFITEX trucks. The buyers contracted by SOFITEX receive a commission.

Second, the "Marche AutoGere" (MAG) which is a buying team within the village groups. This team is made up of farmers who have received training from the ORD. The MAG plays the same role as the classical team. In this system, however, farmers do not receive their money on the day that they market their seed cotton. The cotton collected by the MAG is transported to the ginneries by SOFITEX trucks, where it is weighed again by SOFITEX. A MAG member is present during this weight check. After SOFITEX subtracts short-term loan repayments, the remaining receipts are given to MAG members, who bring them to the village, where they are distributed to farmers. After cotton is bought by SOFITEX, the MAG receives a return (compensation for its work) from SOFITEX. This return belongs to the village groups. Usually they use this money to build schools, dispensaries and pharmacies.

Third, SOFITEX will send a truck directly to the farms of individuals who have produced more than 10 tons of seed cotton and transport their products to ginneries, where the farmers are paid.

Figure 2.3 summarizes the three channels used in cotton marketing. Table 2.9 shows the ammounts of cotton purchsed by the classical team and by the MAGs, as well as direct sales combined.

In 1982, 68 percent of total purchases were done by the MAGs and through direct sales, whereas the classical team purchased 32 percent of total cotton marketed.

Table 2.9 Quantity and Share of Cotton Marketed in 1982

Classical Team		MAG and Direct Sales	
Quantity Purchased (Tons)	% of Purchases	Quantity Purchased (Tons)	% of Purchases
24,482	32	51,090	68

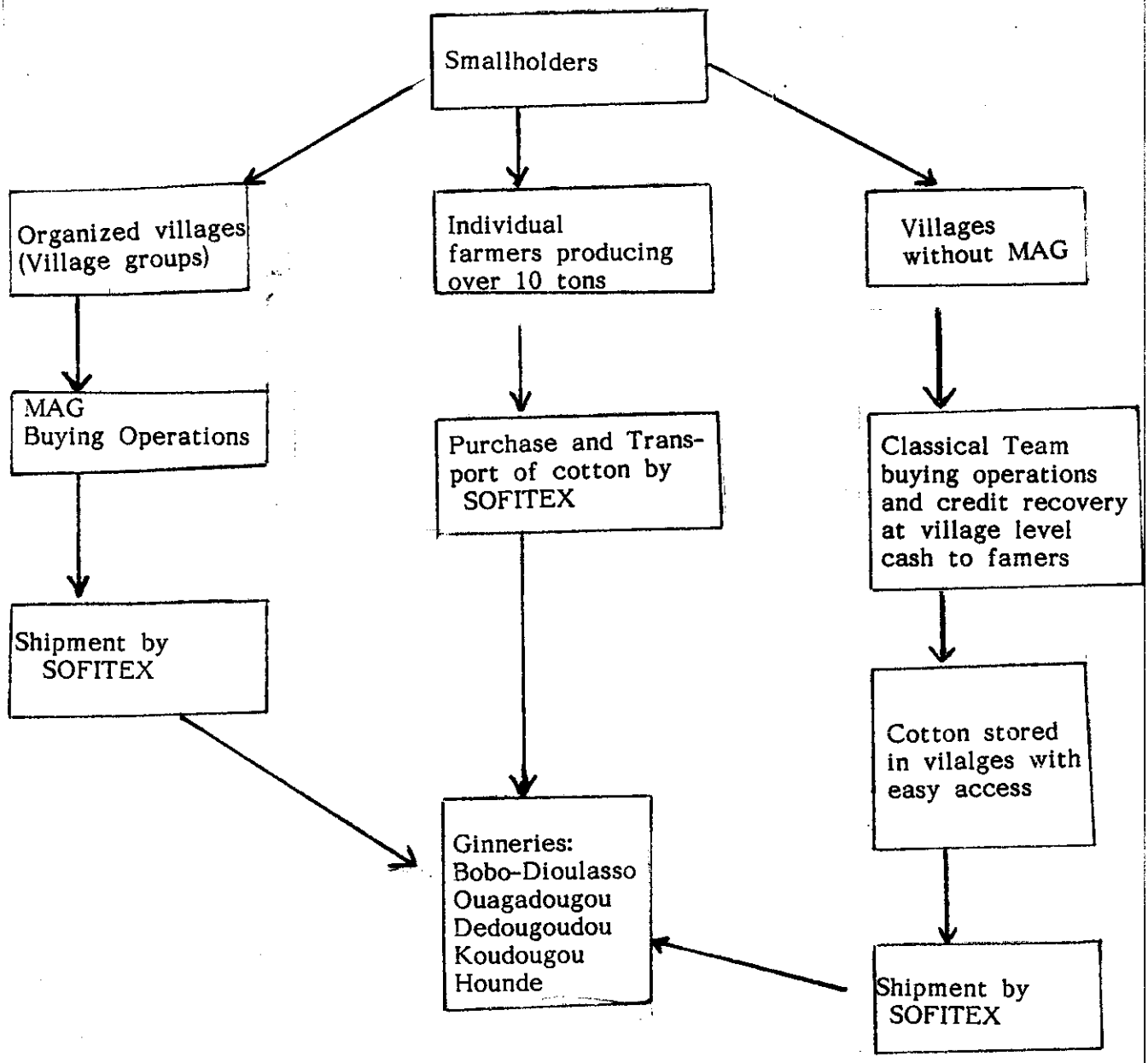
Source: SOFITEX unpublished document (M. Salace, 1984) Ouagadougou

2.6 Cotton Utilization

Figure 2.4 presents the output marekting, input distribution and procesing. That figure also illustrates the destination of the fiber and the seed.

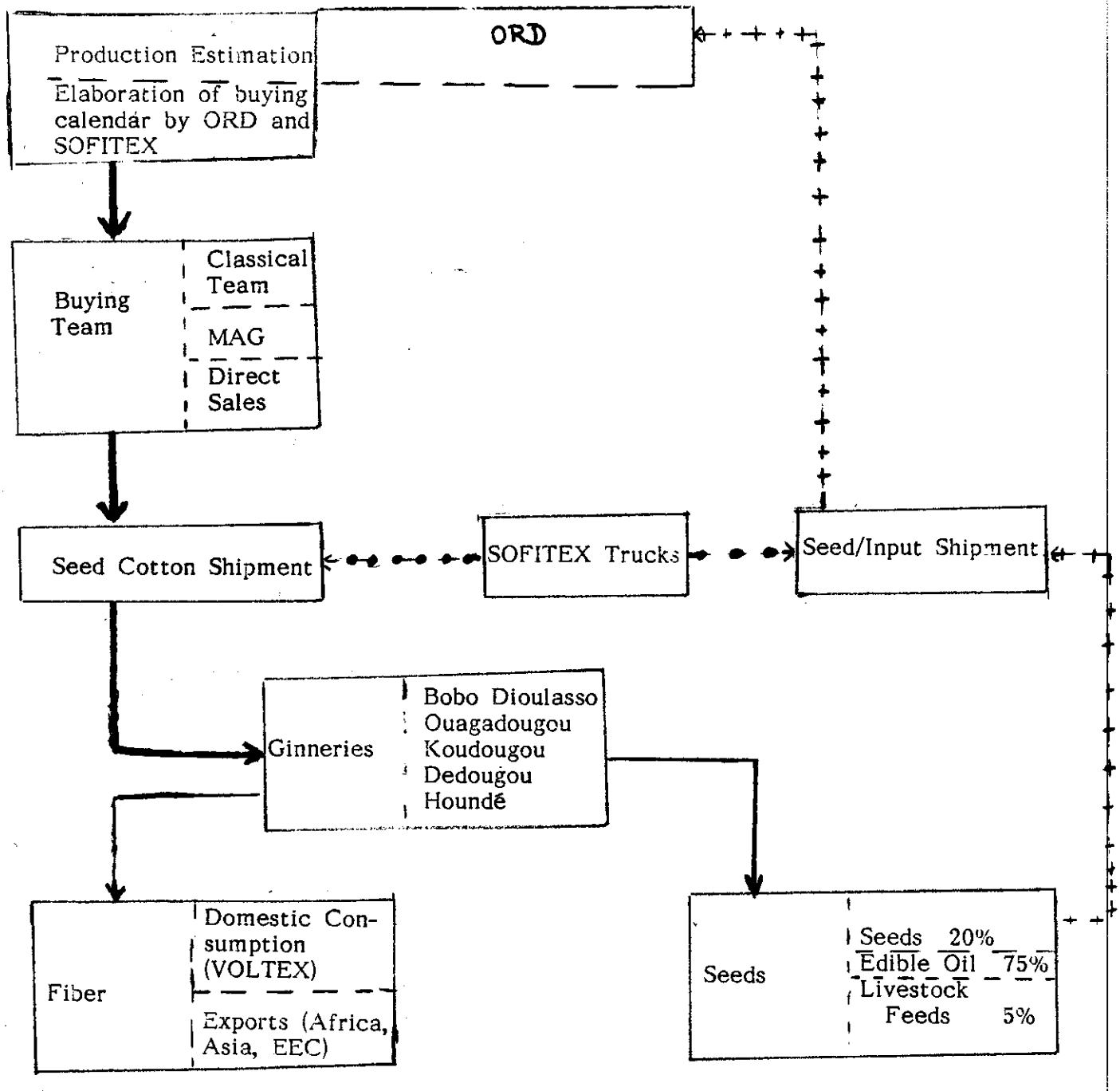
As mentioned before, the separation of fiber and seed is done by SOFITEX. All seeds are consumed at the domestic level. About 20 percent of the seed is used as inputs in cotton production and thus go to farmers; 75 percent of the seed is transformed into edible oil by the Société des Huiles et Savonneries du Burkina Faso (SHSBF); and the remaining 5 percent go to feed livestock. Only 4 percent of the cotton fiber is used by the VOLTEX, and the remaining 96 percent is exported to destinations in Asia, the EEC and Africa. In 1983, about 74 percent of the fiber

Figure 2.3 The Three Channels Used in Cotton Marketing in Burkina



Source: Hauts Bassins ORD. Unpublished document (M. P. Cochelin), 1984. Bobo Dioulasso.

Figure 2.4 Cotton Marketing and Input Distribution



Source: SOFITEX, unpublished data. (Provided by M. Salace of the Ouagadougou office of SOFITEX.

Marketing of seed cotton

Separation of fiber and seeds from ginneries

Shipment of input/seeds

Movement of trucks

was sold to Asia, 19 percent to the EEC and 7 percent to other countries in Africa. Table 2.10 shows the share of trade for each partner importing fiber from Burkina.

Table 2.10 Fiber Trade in 1983

Destination	Quantity (Tons)	% Share	Export Values CFAF Millions	% Share
EEC	5,335	18.5	2,764	17.5
Asia	21,175	73.5	11,562	73.5
Africa	1,910	6.6	1,147	7.3
Others	400	1.4	272	1.7
Total	28,820	100	15,745	100

Source: SOFITEX. Unpublished data (provided by M. Salace, of Ouagadougou SOFITEX Office), 1984.

Institutions involved in cotton production, government price policies, marketing channels, cotton development, cotton cultivation, and its utilization have been discussed. Based on the background in Chapter II, we will develop an economic model of factors influencing cotton supply, and test a statistical model built on the economic model. Chapter III will cover the economic and statistical model, and also the interpretation of the statistical results.

Chapter III

Theoretical Framework

3.1 The Models of Cotton Supply Response

Dr. S. A. Oni, referring to Zusman, states that studies designed to obtain quantitative measures of the price response of growers of annual crops have faced three main difficulties.[1] First, supply functions are defined and analyzed by economic theory in terms of unobservable variables, i.e., in terms of anticipated prices. Second, production response is basically a dynamic process in which formation of expectations and adjustments of farmers' productive capacity play a central role. Unfortunately, these dynamic elements are extremely difficult to express in quantitative units. Third, a problem that usually arises when the production response of a given crop is estimated is the choice of the dependent variable. Should a single equation relating production and prices be estimated, or are separate equations for acreage response and yield response needed? In this tudy, yield and acreage equations are estimated separately because we believe that farmers respond to prices mainly by means of acreage variation, not yield variation.

3.1.1 Agreage Response

The factors that might affect cotton acreage farmers would desire in the long run are the expected cotton return and the unexpected return on competing crops. Prices are used as a measure of return. The reason for choosing these variables is explained as follows. For a cultivator, the decision to commit land to cotton production at any time is related to his

expectations regarding the level of future prices of cotton. In Burkina, commodity prices are fixed by the government during the period of harvesting. In the case of seed cotton, the producer price seems to be set arbitrarily. The competing crop considered in the study is sorghum. It is the major cropping alternative to cotton.

Based on the review of the subsector in Chapters I and II, and on economic theory, we will build an economic model of cotton supply in Burkina Faso.

The information in Chapters I and II suggest that farmers adjust acreage in response to changes in relative cotton/sorghum prices, but that, in any one year, farmers cannot completely adjust to the level they would desire in that year. There are several reasons for this ability to adjust acreage only partially in the short-run.

First, the rotation pattern which allows some crops to benefit from the remaining fertilizer of the previous year. With this cultural method, farmers avoid shifting cultivation. Second, the asset fixity influences farmers to continue growing cotton. Sowing machines and sprayers which already exist on the farm cannot be thrown away. Farmers will use this equipment. Third, once farmers are specialized in cotton production, this ability becomes a habit for them, so they will not easily abandon this "second nature."

From the selected variables, the economic model can be summarized in a mathematical representation:

$$AC_t^* = f(PC_t^*, \quad PS_t^*, \quad U_t)$$

Where,

AC_t^* = long-run equilibrium acreage in hectares.

PC_t^* = expected producer price in CFAF/kg for cotton.

PS^*_t = expected producer price in CFAF/kg for sorghum.

U_t = the disturbance term.

Using the ratio of the expected cotton price to the expected sorghum price, the economic model is a partial adjustment model (Nerlove).

1) $AC^*_t = f(PC^*_t/PS^*_t, V_t)$ or $AC^*_t = \alpha + \beta(PC/PS)^*_t + e_t$

Where: $\beta > 0$

α = intercept

β = coefficient of expected price ratio

e_t = error term.

We assume that one plausible relationship --actual acreage (AC_t) and long-run equilibrium acreage (AC^*_t)--is that, in each period, actual acreage is adjusted in proportion to the difference between acreage desired (AC^*_t) in long-run equilibrium and actual acreage in that period.

This relation is:

2) $\underbrace{AC_t - AC_{t-1}}_{\text{Acreage adjustment from last year to this year.}} = \gamma \underbrace{(AC^*_t - AC_{t-1})}_{\text{Desired change from past year to this year}}$

γ coefficient of adjustment.

Where $0 < \gamma \leq 1$

The coefficient of adjustment indicates the speed of acreage adjustments.

Now we need to transform equation (1) into a form that includes observable variables so that we can estimate it statistically. Substituting equation (1) into equation (2), we have:

$$AC_t - AC_{t-1} = \gamma\left[\alpha + \beta(PC/PS)^*_t + e_t - AC_{t-1}\right]$$

$$AC_t - AC_{t-1} = \gamma\alpha + \gamma\beta(PC/PS)^*_t + \gamma e_t - \gamma AC_{t-1} \quad \text{or}$$

$$AC_t = \alpha\gamma + \gamma\beta(PC/PS)^*_t + \gamma e_t - \gamma AC_{t-1} + AC_{t-1}$$

$$(3) \qquad AC_t = \alpha\gamma + \gamma\beta\left(PC/PS\right)^*_t + (1-\gamma)AC_{t-1} + \varepsilon_t$$

Theoretically, the prices influencing farmers' supply response are those expected to be operative at the time they sell their products. In this study, these expected prices are not known at the time of planting. This leads farmers to guess what price they will receive when they market. Considering that the nominal producer prices have remained constant over two, three and four years, and that prices are fixed after planting, one can conclude that farmers in Burkina might have previous year's price as their expected price. In that case, $\left(PC/PS\right)^*_t = \left(\frac{PC}{PS}\right)_{t-1}$, so the statistical model is

$$(4) \qquad AC_t = \gamma\alpha + \gamma\beta\left(PC/PS\right)_{t-1} + (1-\gamma)AC_{t-1} + \gamma\varepsilon_t$$

The equation can be rewritten as:

$$(5) \qquad AC_t = \Pi_o + \Pi_1\left(PC/PS\right)_{t-1} + \Pi_2 AC_{t-1} + W_t$$

Where,

$$\Pi_o = \alpha\gamma, \quad \Pi_1 = \gamma\beta, \quad \Pi_2 = (1-\gamma) \quad \text{and} \quad W_t = \gamma\varepsilon_t$$

In equation (5), Π_1 and Π_2 are expected to be positive. Having estimated the parameters (Π's) of the reduced form equation, the parameters in the original structural equation are derived as follows:

$$\hat{\gamma} = 1 - \hat{\Pi}_2, \quad \hat{\beta} = \frac{\hat{\Pi}_1}{\hat{\gamma}}, \quad \hat{\alpha} = \hat{\Pi}_o/\hat{\gamma}$$

From the equation (5), we can calculate the short-run and long-run price response parameters.

Short-run effect = Π_1

Long-run effect = $\Pi_1/1-\Pi_2$

3.1.2 Yield Response Model

The yield response includes theprice of the major input (fertilizer) bought by farmers, rainfall and a time trend. Acreage, cotton price and a relative cotton/fertilizer price are not used in the final yield equation because, in earlier estimations, coefficients of these variables did not coincide with the expected sign. Cotton price and a relative cotton/fertilizer price had a negative sign instead of positive. The sign of acreage coefficient was positive, contrary to the expected sign.

Rainfall has been considered as one of the main determinants for production in Burkina, where irrigation for cotton does not exist. The price of fertilizer is also used as a factor that influences the yield. The yield is affected by the use of fertilizer and use declines as price increases.

Finally, the time trend variable represents a proxy for the changes in cotton production technology and extension services. The coefficients of rainfall and time trend are expected to be positive, whereas that of input price is expected to be negative.

The yield equation is thus expressed as follows:

$$YIE_t = f(PF_t , RF_t , T , V'_t)$$

$$YIE_t = a_o + a_1 RF_t + a_2 PF_t + a_3 T + V'_t$$

Where

YIE_t = annual average yield in year t, in kilogram/hectare

RF_t = annual rainfall in year t (mm)

PF_t = price of fertilizer in year t, CFAF/kilogram

T = time trend (1, 2 . . . 17) 1965 = 1

V'_t = error term

a_o = intercept

a_1 , a_2 , and a_3 are parameter estimates.

The consumer price index is used to deflate all nominal prices included in the study. Deflating not only expresses all prices in real terms, it also helps to reduce the high correlations among explanatory variables by taking out the effect of inflation on nominal prices.

3.1.3 Functional Form

The previous discussion of the model specification has centered exclusively on which variables should be included. Specifying the relationship among them is also very important. The Cobb Douglas, or power, function is used for acreage and yield response models. The models are estimated using the natural logarithm of all variables. This method allows direct determination of elasticities. An L is used before the variable code to indicate that the variable is in logarithmic form. For example, LAC_t is the log of cotton acreage in year t.

3.2 Results of the Study

The acreage response model hypothesizes that acreage is affected by the lagged dependent variable (AC_{t-1}) and the lagged price ratio $(PC/PS)_{t-1} = RAS_{t-1}$. In addition, the yield is affected by current price of input (fertilizer), a time trend which reflects the effects of technology and extension, and by rainfall. The data used for estimating the acreage equation begins in 1961 and ends in 1981. In the case of the yield equation, data used start in 1965 and end in 1981. This shorter time span is the result of the lack of information related to the price of fertilizer in the early 1960s. Acreage and yield equations were estimated using ordinary least squares (OLS). The ordinary least squares method gives the best straight line that fits the sample of observations in the sense that it

minimizes the sum of the squared (vertical) deviations of each observed point on the graph from the straight line. This classical regression model (OLS) is based on five assumptions:

1. The first assumption of the classical linear model is that the random error term (u) is normally distributed.
2. The second assumption is that the expected value of the error term equals zero -- $E(Ui) = 0$.
3. The third assumption is that the variance of the error term (u) is constant for all observations, i.e., $E(Ui)^2 = \sigma_u^2$.
4. The fourth assumption is that the value which the error term assumes in one period is uncorrelated to its value in any other period; that is, $E(Ui, Uj) = 0$ for $i \neq j$, $i, j = 1, 2, \ldots$
5. The fifth assumption is that the explanatory variable assumes fixed values that can be obtained in repeated samples, so that the explanatory variable is also uncorrelated with the error term, that is,

   $E(Xi, Ui) = 0$ where Xi = explanatory variable

   Ui = error terms

Since serial correlation is usually present in time series data, the Cochrane-Orcutt procedure is used to correct for serial correlation. This procedure involves a series of iterations to estimate the correlation coefficient associated with errors of adjacent time periods. Considering the acreage model, OLS is used to estimate it:

$$LAC_t = \Pi_o + \Pi_1 LRAS_{t-1} + \Pi_2 LAC_{t-1} + \theta_t$$

The residuals of this equation are then used to perform the regression:

$$\Theta_t = \rho \Theta_{t-1} + \Theta'_t$$

The estimated value φ is used to perform the generalized differencing transformation process, and new regresssion is run. The transformed equation is:

$$LAC_t - \hat{\varphi}LAC_{t-1} = \Pi_0(1 - \hat{\varphi}) + \Pi_1(LRAS_{t-1} - \hat{\varphi}LRAS_{t-2}) + \Pi_2(LAC_{t-1} - \hat{\varphi}LAC_{t-2}) + \Theta'_t$$

The standard procedure is to continue this procedure iteratively, stopping the iteration when the new estimate of φ differs from the previous estimate by less than .01 or .005, or after 10 or 20 iterations.

3.2.1 Estimation of the Equations

Many attempts were made to estimate different specifications of the acreage and yield equations. Two equations were finally selected. The choice of these equations was based on the signs of the coefficients and adjusted $\bar{R}^2$. Adjusted $\bar{R}^2$ is preferred over R^2 because it takes into account the reduction in degree of freedom as more explanatory variables are introduced into the model. (R^2 never decreases with the introduction of another independent variable.)

The two estimated equations are presented below:

1. $LAC_t = 4.05 + .022LRAS_{t-1} + .634LAC_{t-1}$

$$\begin{matrix} 1.96^* & .117^* & .174^* \\ (2.06) & (.192) & (3.63) \end{matrix}$$

$R^2 = .717$

$\bar{R}^2 = .660$

$F = 12.60$

2. $LYIE_t = -3.14 - .498LRPF_t + 1.14LRF_t + .512LT$

3.57*	.196*	.522*	.082*
(-.879)	(-2.53)	(2.19)	(6.21)

$R^2 = .906$

$\bar{R}^2 = .885$

$F = 42.06$

$Dw = 2.32$

Where

* standard error

t values are in parentheses

LAC_t = natural logarithm of acreage

$LRAS_{t-1}$ = natural logarithm of the relative cotton/sorghum price price, lagged one year;

LAC_{t-1} = natural logarithm of acreage, lagged one year;

$LYIE_t$ = natural logarithm of yield;

$LRPF_t$ = natural logarithm of deflated fertilizer price;

LRF_t = natural logarithm of rainfall; and,

LT = natural logarithm of time trend.

The short-run elasticities were obtained by taking the coefficient attached to lagged price ratio, but the long-run supply response = short-run supply response ÷ 1 - the coefficient of lagged output .

In the acreage response equation (1), the short-run and long-run supply responses with respect to price ratio ($^{PC}/_{PS}$) are .02 and .06 respectively. In the yield response equation (2), the short-run supply response with respect to fertilizer price is about -.5.

3.2.2 Interpretation of the Results

The R^2 and adjusted $\bar{R}^2$ for the average equation are respectively .717 and .660. R^2 says how much of the variation in the dependent variable is associated with the variations in the independent variables. The signs of coefficients of the price ratio variable and lagged acreage are positive as expected. In the acreage equation, the constant term and the coefficient of lagged acreage are significant at the .05 level since the calculated ts are larger than the tabulated t (2.06 and 3.63 Vs 1.74). In contrast, the coefficient of the price ratio is not significant at the .05 level. In this case, the null hypothesis which is $\Pi_1 = 0$ cannot be rejected. The overall statistical significance is given by the calculated F which is greater than the critical F at .05 level. Applying ordinary least squares resulted in a Durbin h statistic equal .67 which indicated significant serial correlation at the .05 level. The Cochran-Orcutt correction procedure was used even though it technically is not correct because of the lagged dependent variable on the right hand side.[2]

In the yield equation, the rainfall, the fertilizer price and the time trend coefficients had the expected signs. In that equation, the time trend and the rainfall coefficients were significantly different from zero at .05 level. A large amount of the variance in yield is associated with the exogenous variables. The percentage is given by R^2 and adjusted $\bar{R}^2$ which were .906 and .885, respectively.

The main reason for estimating the acreage and yield equations was to obtain estimates of the various elasticities in order to help answer the policy equations posed at the beginning of this study. When cotton and sorghum prices were introduced separately in the acreage equation, we found high multicollinearity between the two variables. After correcting for serial correlation, the coefficient of cotton price was found to be negative.

The interpretation of the elasticities can be made clearer by a specific example. From the acreage equation (1), the short-run price ratio elasticity of acreage reponse equals .02 indicates that, with the effect of other independent variables remaining constant, an increase of one percent in the cotton/sorghum price ratio will lead to about .02 percent in acreage of cotton in Burkina.

The long run price ratio elasticity (.06) is greater than short-run elasticity, suggesting that cotton growers are more responsive to variation in the cotton/sorghum price ratio in terms of long-run adjustments. It is also important to mention that many studies on acreage response to price have led to low elasticities. For instance, Askari and Cummings[3] found a short-run elasticity of .05 and long-run elasticity of .08 for cotton in Gujarat region in India.

Again, considering the other factor constant, a one percent incrase in rainfall can lead to 1.14 percent increase in yield. Also, a one percent increase in the price of fertilizer can be expected to lead to a decrease in yields of .5 percent. Finally, a 50 percent change in time trend can lead to 25 percent increase in yield. Yield is increasing over time as indicated by the trend variable. For example, moving from 1981 to 1982 would increase T from 17 to 18. This 5.9 percent increase in T would result in a 3 percent increase in yield associated with these factors underlying the trend variable.

The acreage planted to cotton in any given year is largely dependent upon what farmers have earned from their cotton enterprise in preceding years. If, for example, the price of cotton has been falling, fewer hectares will be seeded. In the next chapter, the econometric results will be used to analyze the two policy issues evoked earlier.

Footnotes

1. S. A. Oni. "Econometric Analysis of Supply Among Nigerian Cotton Growers." Bulletin of Rural Economics and Sociology. Vol. 4, no. 2, 1969. Department of Agricultural Economics, University of Ibadan, Nigeria.

2. Robert S. Pindyck and Daniel L. Rubinfeld. Econometric Models and Economic Forecasts (Second Edition). New York: McGraw-Hill, 1981, p. 194.

3. Hossein Askari and John Thomas Cummings. "Estimated Agricultural Supply Response with the Nerlove Method." Internaitonal Economic Review, June 1977, vol. 18, no. 2, pp. 257-292.

Chapter IV

Policy Analysis Using the Model

As mentioned in Chapter I about 90 percent of the population in Burkina Faso dwells in rural areas and earns a living mainly through small farming. The 1977-1981 Plan sets forth three national objectives: improved living conditions for all the population, self-sufficiency in food, and a reduction in undevelopment. The two specific goals for the agricultural sector are to replace food imports with increased cereal production and to diversify into export crops.

In this study, an attempt was made to investigate the factors that affect farmers in making their production decisions with respect to cotton production for export. A supply response model has been developed which includes both acreage and yield equations. The analysis and results presented in this paper bear directly on a number of issues that should be of concern to policy makers in Burkina Faso. However, the results of this study are applied in two ways. First, a discussion related to price policy influences on the production level and, second, an analysis with regard to government's decision to remove fertilizer subsidies.

The results indicate that producer price policy given existing conditions does not influence cotton production. The estimated price elasticity was very low and not statistically different from zero. The two reasons for this is that farmers' expected price was assumed to equal the previous year's price. However, this is not a completely realistic assumption as can be seen in Table A.1. Second, in Hauts Bassins and Volta Noire ORDs, the government policy emphasizes both increased food crop and cotton

production. If the price of crops were announced prior to or during the planting period, maybe there would be significant short-run and long-run elasticities.

Given the current conditions, price policy is not an effective mechanism for increasing cotton production in the short-run. Emphasis on credit policy, extension services and other programs may be more effective. Another alternative would be to announce prices prior to planting decisions.

Our second concern in Chapter I was the subsidy issue. For a long time, inputs have been subsidized by SOFITEX. Now, the government under World Bank pressure, plans to remove these subsidies gradually. If the price of fertilizer to the farmer increases, the amount of fertilizer applied will probably fall. In order to increase the marginal value product the yield will decrease by .5 percent for each percent increase in fertilizer price.

Considering the decrease in yield, a financial analysis was conducted of the government revenues earned from the cotton subsector. The analysis is based on 1981 data with production of seed cotton (57,542 tons), farm gate fertilizer price (42 CFAF), the subsidized fertilizer price to the ORDs (35 CFAF), the total quantity of fertilizer used in 1981 (7,500 tons). The subsidy rate used (64%) is that prevailing in the Hauts Bassins ORD in 1981. This subsidy rate is used to calculate the unsubsidized fertilizer price to ORD (57.4 CFAF/kg). Assuming ORD's margin unchanged, the input cost to farmers will increase by 53 percent, leading to a decrease in cotton yield by 26.5 percent.

Again assuming no change in acreage, seed cotton would decrease by 15,249 tons. Annually, SOFITEX exports about 96 percent of cotton production. If we assume that the proportion exported remains the same, we can calculate government's losses. These losses include the reduction

of cotton levy and export tax that the government gets from SOFITEX. Cotton levy is a kind of tax that the government receives from SOFITEX. The amount of cotton levy and export tax are 4500 CFAF/ton and 1000 CFAF/ton respectively. Multiplying the decreased production (15,248 tons) by 4500 CFAF and 1000 CFAF, and adding them, we get the total reduction of government revenues (83,259,540 CFAF).

At the benefit side, we calculate what the government would save by removing the subsidy. The amount of the savings is obtained by multiplying the savings CFAF per each kilogram of fertilizer by total fertilizer used. The government saves 168,000,000 CFAF.

After we calculate the benefit/cost ratio which is 2.02, we found a net savings of 84,740,460 CFAF to the government. This net savings divided by SOFITEX's dividends and profit taxes (540,000,000 CFAF), we get .16. The government would be worse off if the taxes on profit and dividends of SOFITEX fall by more than 16 percent of the SOFITEX total profits and dividends in 1981. Table 4.1 shows the different steps followed to obtain the results of the analysis.

In this chapter, we considered only some implications of the increase in fertilizer price and the removal of subsidy on input. Farmers' input cost may increase by 53 percent. The government may gain from World Bank's recommendation.

The last chapter covers the summary and conclusions of this study. The findings in Chapter IV will be used to make some suggestions.

Table 4.1 Implications of Subsidies Removal (1981 base)

	Different Stages of Calculations	Values
1.	The subsidy rate: $\frac{\text{Subsidy Cost}}{\text{Fertilizer cost at Bobo Dioulasso station}}$	
	$\frac{70464}{110464}$	64%
2.	Subsidized fertilizer price at ORD level	35 CFAF/kg
3.	Subsidized price to farmers on short-term loan	42 CFAF/kg
4.	The margin to ORD (42-35)	7 CFAF/kg
5.	Unsubsidized fertilizer price to ORD 35 x 1.64	57.4 CFAF/kg
6.	Farmer would pay (assuming ORD's margin remained unchanged) 57.4 + 7	64.4 CFAF/kg
7.	Percentage increase over subsidized price $\frac{64.4}{42} - 1$	53%
8.	The yield would decrease by 53% x .5	26.5%
9.	Cotton production on current acreage would decrease (65,240 ha x .882T/ha) x .265	15,249 Tons
10.	Cotton levy would fall by 4500 CFAF/T x 15,249	68,620,500 CFAF
11.	Export tax would fall by (.96 x 15,249T) x 1000 CFAF/T	14,639,040 CFAF
12.	The reduction in government revenues from just these two sources: 68,620,500 + 14,639,040	83,259,540 CFAF
13.	Government savings per each kilogram of fertilizer $\frac{35 \times 64}{100}$	22.4 CFAF
14.	Fertilizer used on cotton production in 1981	7500 Tons
15.	The government would save: (22.4 x 1000) x 7500	168,000,000 CFAF
16.	Benefit/cost ratio $\frac{168,000,000}{83,259,540}$	2.02

Table 4.1 (Continued)

	Different Stages of Calculation	Values
17.	The net savings to government 168,000,000 - 83,259,540	84,740,640 CFAF
18.	Net savings/SOFITEX's dividends and profit taxes ratio $\frac{84,740,460}{540,000,000}$	.16

Source: Subsidy rate, seed cotton price obtained from unpublished document provided by M. P. Cochelin (Advisor, Hauts Bassins ORD Director). Bobo Dioulasso, 1984.

Chapter V

Summary and Conclusions

5.1 Summary of the Study

This study has focused on the cotton subsector in Burkina. Although the country does not play a significant role in the world cotton market, cotton exports are an important source of income to farmers in the country. Cotton also represents a major source of government revenues.

The historic evolution of cotton production in Burkina was analyzed covering three periods: 1) precolonization; 2) colonization; and 3) post-colonization. During the precolonization, there was no foreign intervention in the cotton production process. Once the country was colonized, the colonial administration started regulating the development of cotton cultivation. The school farm and school village models were used to teach farmers how to grow cotton. After the independence, the structure inherited from the colonization still remains in the cotton subsector.

Cotton marketing follows three channels: classical team developed in the early cotton development; the MAG of the village groups; and the isolated individual shipment.

In addition to the description of the cotton subsector, another purpose of the study was to describe the nature of supply response among the Burkinabe cotton growers. Two econometric equations portraying the structural relationships in the cotton subsector were formulated. The first model (acreage) is based on the hypothesis that farmers respond to changes in price by the way of acreage adjustments. The second model (yield response model) considers the changes in input price, rainfall and trend as a

proxy for change in technology. The Cobb-Douglas function was used as functional form. Ordinary least squares (OLS) multiple regression techniques were utilized in estimating the postulated econometric models. Correction for serial correlation was done by using Cochrane-Orcutt procedure.

The findings of the regression analysis indicate that we cannot reject the null hypothesis related to the coefficient of the cotton/sorghum price ratio. Of the variables used in the acreage equation, the cotton/sorghum price ratio was not found to be an important variable generating changes in cotton acreage. This means that cotton price is not a useful policy variable for influencing cotton production under current conditions. We were also limited in the policy options that we could evaluate to those which had changed over time. For example, we could not study the effect of cotton price on acreage under a policy of announcing prices prior to planting. Study of fertilizer subsidy issue required extrapolation beyond the range of observations.

Emphasis on credit policy, extension services and other programs may be more effective. Another alternative would be to announce prices prior to planting decisions.

In the yield equation, all variable (rainfall, price of fertilizer, and time trend) were found relevant. The study revealed that the yield decreases by .5 percent if the price of fertilizer were increased by one percent. The fertilizer price can be used as policy variable in order to increase the yield leading to an increase in production. In Table 4.1, there are calculations showing the effect of implementing the World Bank's recommendation to the government that input subsidies be removed. We could not talk about net savings or net costs to the government because of a lack of information related to the tax rate. We also did not calculate any effect on farmers' income.

5.2 Limitations of the Study

In this study, we assumed constant elasticity because we used Cobb-Douglas as a functional form. We were also limited by the current policies. Fertilizer subsidy issue requires extrapolation beyond the observations.

5.3 Recommendations

It would be useful to conduct a socioeconomic study, disaggregate the national model by specifying and estimating acreage supply response equating and yield response equation for each cotton growing ORD, especially for Hauts Bassins and Volta Noire ORDs.

A linear programming analysis based on representative farms would help as understand the decision being made by the individual farmer with respect to cotton acreage. The study may also help us understand the implications of certain policy measures for resource allocation in the Burkina cotton subsector. It also could be used to study the effects of changing input or product prices.

As a conclusion, I hope this study will serve SOFITEX as well as the government for future policies related to the cotton subsector in Burkina Faso.

APPENDIX

Data Used in the Econometric Analysis

Table A.1 Data Used in the Econometric Analysis

Years	Rainfall (mm)	Planted Area (1000 ha)	Yield kg/ha	Production (1000 T)	Nominal Cotton Price CFA/kg	Fertilizer NPK (1000 kg)	Nominal Fertili-zer Pr. CFA/kg	Nominal Sorghum Price CFA/kg	CPI (1970 = 100)
1961	836.7	22.9	113	2.5	34	--------	-----	12	88.8
1962	758.3	36.0	183	6.5	32	--------	-----	12	89.8
1963	984.5	45.8	186	8.0	33	--------	-----	15	90.7
1964	981.7	52.5	170	8.7	34	--------	-----	13	92.6
1965	865.2	49.7	137	7.4	34	--------	35	11	91.8
1966	869.7	52.3	311	16.2	34	200	32	13	93.9
1967	771.5	65.4	264	17.2	32	400	35	14	20.4
1968	961.0	71.6	447	32.0	32	800	35	12	89.9
1969	923.0	84.0	431	36.2	32	1300	38	12	96.8
1970	844.2	80.5	291	23.4	32	1300	37	12	100
1971	736.7	74.0	379	28.1	32	1700	37	12	102.1
1972	787.7	70.0	465	32.5	32	1500	37	12	99.1
1973	709.2	66.6	413	26.6	35	1700	37	14	106.6
1974	892.5	61.5	497	30.5	40	1800	37	18	115.9
1975	752.1	68.0	745	50.6	40	2500	37	22	137.7
1976	839.2	79.2	691	55.2	40	3600	37	18	126.1
1977	679.5	68.7	553	38.0	55	3200	37	32	167.6
1978	829.7	71 7	837	59.9	55	5000	37	40	218.7
1979	753.0	82.0	945	77.5	55	7200	37	40	204.1
1980	788.4	74.9	834	62.5	55	7400	42	40	229.0
1981	751.6	65.2	882	57.5	60	7500	42	45	246.3

Source: Please see listing on following page.

Table A.1 (Continued

Sources

Data for rain (1961-75) are from World Meteorological Organization Monthly Climatic Data for the World. Data from 1976 to 1981 are obtained from FAO/PAM Rapport de Mission de l'évaluation de la situation alimentaire (Rome, 1980).

Cotton and sorghum prices are from CILSS/Club du Sahel: Développement des cultures pluviales en Haute-Volta, (September 1982), p. 60, and from World Bank: Upper Volta, Agricultural Issues Study. Cotton area, yield and production are from SOFITEX: Rapport SOFITEX Campagne 1982-83. Ouagadougou. Fertilizer data provided by M. Salace (Ouagadougou, SOFITEX Office).

Currency Equivalents

Exchange Rates:[1] U.S. $1.00 Equivalent in CFAF

Year	Exchange Rate	Year	Exchange Rate
1961	246.8	1972	252.2
1962	246.8	1973	222.7
1963	246.8	1974	240.5
1964	246.8	1975	214.3
1965	246.8	1976	238.9
1966	246.8	1977	245.6
1967	246.8	1978	225.6
1968	246.8	1979	212.7
1969	258.1	1980	210.0
1970	277.7	1981	205.0
1971	277.0		

[1]Period average

Weights and Measures: Metric System

Metric	British/U.S. Equivalent
1 Kilometer (km)	.62 miles
1 Hectare (ha)	2.47 acres
1 liter (l)	1.057 quarts
1 metric ton (MT)	1.1 tons
1 kilogram (kg)	2.2046 pounds

Source: World Bank. Upper Volta Agricultural Issues Study, Report #3296 UV, October 1982.

List of Abbreviations

1.	ACC	Cotton Colonial Association (Association Cotonnière Coloniale)
2.	ARCOMA	Regional Factory for Agricultural Equipment (Atelier Regional de Construction de Matériels Agricoles)
3.	BCEAO	Central Bank of West African States (Banque Centrale des Etats de l'Afrique de l'Ouest)
4.	BICIA	International Bank for Trade, Industry and Agriculture (Banque Internationale pour le Commerce l'Industrie et l'Agriculture)
5.	BIV	Volta International Bank (Banque Internationale des Voltas)
6.	CILSS	Permanent Inter-State Committee of Drought Control in the Sahel (Comité Permanent Inter-Etats de Luttes Contre la Secheresse)
7.	CNCA	National Credit Fund for Agriculture (Caisse Nationale de Crédit Agricole)
8.	CFDT	French Company for the Development of Textile Fibers (Compagnie Française pour le Développement des Fibres Textiles)
9.	DIR	Rural Institutions Directorate (Direction des Institutions Rurales)
10.	EEC	European Economic Community
11.	FAO	Food and Agricultural Organization of the United Nations
12.	IFDC	International Fertilizer Development Center
13.	IRCT	French Research Institute for Cotton and Textiles (Institut de Recherches du Coton et des Textiles Exotiques)
14.	MAG	Self-Managed Market (Marche AutoGere)
15.	ORD	Regional Development Office (Organisme Regional de Développement)
16.	SHSBF	Parastatal Company for Oil and Soap(Société des Huileries et Savonneries du Burkina Faso)
17.	SOFITEX	Parastatal Company for Cotton (Société des Fibres et Textiles)
18.	VOLTEX	Volta Textiles

Bibliography

Association en Participation République de Haute-Volta - CFDT. La Campagne Cotonnière 1971-72. Rapport Annuel Ouagadougou. May 1972.

_____. La Campagne Cotonnière 1972-73. Rapport Annuel. Ouagadougou, June 1973.

_____. La Campagne Cotonnière 1973-74. Rapport Annuel. Ouagadougou, June 1975.

_____. La Campagne Cotonnière 1975-76. Rapport Annuel. Ouagadougou, June 1976.

_____. La Campagne Cotonnière 1977-78. Rapport Annuel. Ouagadougou, July 1978.

Bloud. Problème Cotonnier et l'Afrique Occidentale Française. Paris. Librairie Emile Larose, 11, Rue Victor-Cousin, 1925.

C. Peter Timmer, Walter P. Falcon, Scott R. Pearson. Food Policy Analysis. The Johns Hopkins University Press. 1983.

Henry. Coton dans l'Afrique Occidentale Française. Augustin Challamel, Editeur. Paris: Librairie Maritime et Coloniale. 1906.

Hossein Askari and John Thomas Cummings. "Estimated Agricultural Supply Response with the Nerlove Model." International Economic Review, June 1977. vol. 18, no. 2.

Michel Desmidts. Projet PNUD/FAO. Phyllodie du Cotonnier. UPV-72/-015. Rapport d'Activités (June-December), Ouagadougou, 1973.

Moore. Forecasting the Yield and Price of Cotton. New York. 1917.

Nerlove, Marc. The Dynamics of Supply. Estimation of Farmers' Response to Price. Baltimore, Maryland: Johns Hopkins University Press, 1958.

Oni, S. A. "Econometric Analysis of Supply Response Among Nigerian Cotton Growers." Bulletin of Rural Economics and Sociology, IV, no. 2, 1963.

Paddock, Brian W. "Supply Analysis of Rapeseed Acreage." Canadian Journal of Agricultural Economics, XIX, July 1971.

R. Lagière. Le Cotonnier. Limoges, France, 1966.

République de Haute Volta. Section d'Experimentation de Bobo-Dioulasso. Rapports Annuels (1974-1979). IRCT, Paris, France.

Robert S. Pindyck and Daniel L. Rubinfeld. Econometric Models and Economic Forecasts, 2nd Edition. New York: McGraw-Hill, 1981.

Saylor. Variations in Sukumaland Cotton Yields. Economic Research Bureau. University College, Dar es Salaam, 1970.

Todd. World's Cotton Crop. London: A and C Black, 1915.

Tomek, W. G. and K. L. Robinson. Agricultural Product Prices, 2nd Edition. Ithaca, New York: Cornell University Press, 1981.

USDA. Round the World with Cotton. Government Printing Office, Washington, D. C. 1941.

World Bank. Upper Volta Agricultural Issues Study Report #3296 UV, October 1982.