AN ECONOMETRIC STUDY OF SUPPLY AND DEMAND FOR PEANUTS AND PEANUT OIL: IMPLICATIONS FOR SENEGALESE AGRICULTURAL POLICY

by

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LIST OF ACRONYMS

BCEAO = West African Central Bank grouping Senegal, Upper Volta, Niger, Ivory Coast, Benin, and Togo.

FAO = Food and Agriculture Organization of the U.N.

OCA = Senegalese marketing board created in 1961 to purchase peanuts from producers and sell to the oil mills.

OCAS = Senegalese public agency created in 1967.

ONCAD = Senegalese marketing board created in 1966 which marketed the peanut produce to the OCAS.

SONACOS = Public agency created in 1975 for peanut oil marketing.

SONAR = Public agency created in 1980 for provision of seed, fertilizer and farm machines to the agricultural sector.

SEIB = Oil mill located in Diourbel-Louga region.

SODEC = Oil mill located in Sine-Saloum region.

SEIC = Oil mill located in Casamance region.

USAID = United States Agency for International Development.

USDA = United State Department of Agriculture.

CHAPTER 1

INTRODUCTION

Senegal, like most developing countries is primarily agricultural, with about 65 to 70 percent of the population deriving livelihood from farming. Farms of less than ten hectares account for about 95 percent of all production. Production per hectare is relatively low throughout the country due to low soil fertility and continued use of traditional methods of cultivation (Jabara and Thompson, 1980). However, research has shown that with use of modern technology, such as improved seeds, fertilizer, etc., yield per hectare can double and even triple. Despite the variety of crops grown, peanuts represent by far the most important single crop, being cultivated all over the country, and accounting for more than half the total area cultivated in 1976 (CSCE 1978). Peanut production was introduced during the colonial period, and since then continues to represent a valuable source of foreign exchange earnings. Furthermore, the peanut oil serves the domestic consumer market. The export value of peanuts and peanut products amounted to 40 billions CFA francs in 1973 and 34 billions in 1974 (CSCE 1978). In percentage terms, the peanut and its derivatives provided 41 percent of the total Senegalese earnings in 1975.

Importance of the Study

Being a major participant in the international trade for peanuts, Senegal plays a significant role in the world peanut market. However, both internal and external developments have greatly affected the Senegalese peanut industry in recent years.

On the internal side, Senegal depends heavily upon rainfall which has been very erratic in recent years. Furthermore, management

inefficiencies within the former Oncad marketing board and the failure of some state enterprises in the seventies have reduced the foreign exchange earnings derived from peanut and peanut oil production that could otherwise have been used for development purposes (increase of basic needs). In addition, farmers appear to be reluctant to adopt fully the improved technological packages proposed by researchers because of the levels of incentives that actually prevail. Indeed, the government has tried continuously to provide incentives for farmers through provision of credit, technical inputs and farm machinery. But in most cases either there is a delay between the time the inputs are available at the farm level and the time they are really needed or the pricing policy is such that it tends to discourage farmers from purchasing the amount needed for the proposed technological packages to have real impact. At the external level, peanuts are facing a very strong competition in the world oilseed market. International trade of various oilseeds that are substitutes for peanuts and peanut oil has arisen in recent years. This situation coupled with the erraticism in rainfall and farmers reluctancy toward adopting proposed new practices have made it difficult for Senegalese peanut oil exports to compete in world markets.

Before the accession of France to the EEC, Senegal benefited from absolute quotas under a guaranteed price well above world market prices. However, with the accession of France to the EEC, Senegal had to face world peanut market regulation. Even so, France continued to be the first importer of Senegalese peanut and peanut oil. In recent years, Senegal has not been able to meet its total exports quotas to France which brought France to seek for other potential markets and eventually other oilseeds as substitutes for peanut and peanut oil. Thus, in view

of the various adjustments that are necessary to cope with the new economic environment, studies that enhance further understanding of the different factors involved in the Senegalese peanut industry are needed. Such studies can provide information that can be helpful for future policy.

Objective of the Study

The main objective of the present study is to provide further understanding in factors involved in the Senegalese peanut industry both domestically and at the international level.

Specifically, the objectives are:

1. To describe the international market for peanuts and peanut oil and to assess the position of Senegal in the market.
2. To describe the Senegalese marketing system for peanuts and peanut oil.
3. To estimate domestic supply and demand for peanuts and peanut oil.
4. To estimate different regional supply (sales) models.
5. To make projection of the future trend of Senegalese peanut oil demand and peanut oil exports.
6. To investigate the Senegalese exports models for peanuts and peanut oil.
7. To investigate the impact of peanut price policy on rural-urban terms of trade.
8. To formulate recommendations based on findings of the study.

This work is divided into ten chapters, Chapter 1 being the introduction. In Chapter 2, a brief review of existing studies of peanuts and peanut oil are made. Chapter 3 deals with the world peanut economy and Chapter 4 with the Senegalese peanut economy. These chapters

include examination of the substitutes for peanuts and peanut oil vis-a-vis their price correlation matrices. Chapter 5 presents the theoretical framework while Chapter 6 reports analyses and results of the national, official (sales) and regional (sales) supplies for peanuts, and the demand for peanut oil by consumers. Chapter 7 presents projections of the domestic peanut oil demand and peanut oil exports. Chapter 8 reports the investigations of Senegalese peanut and peanut oil export models. Chapter 9 presents analyses of the exchange relationship between farmers and the government within the sphere of peanut price policy. Chapter 10 summarizes the study findings and recommendations.

CHAPTER 2

LITERATURE REVIEW

2.1 Senegalese Studies

Samir Amin, presenting the political economy of the former French West-Africa (1974), pointed out that Senegalese peanut production in 1884-1885 was 45,000 tons unshelled; it increased to 200,000 tons in good years before 1914. The 1936-1937 harvest reached 600,000 tons. He discovered that with a price of peanuts of 18 Francs CFA/Kg (1967 producer price), modernization was not worthwhile unless land was available and was situated in areas with the necessary rainfall (i.e., the central and southern sections of the country). He also observed that economic incentives to adopt new methods were relatively slight, but that modernization would be essential if an increase in peanut production was taken as a goal, i.e., if Senegal's continued development was seen as inevitably based on the cultivation of peanuts. In analyzing the transportation cost of peanuts, Samir Amin reported that the cost of sea transport had gradually decreased from 11 percent of the peanut value reaching European ports in 1890-1900 to 5 percent in 1927-1928 and to 3.5 percent in 1958-1959. Between 1925 and 1935 the real cost of inland transport, according to Amin, ranged from 20 to 9 percent of the value of the peanuts at the point of sale for an average journey of 20 kilometers.

Subsequently, Amin, in analyzing the world peanut trade, noted that the world price of peanuts was relatively stable between 1885 and 1914. However, the period 1925-1940 was one of acute depression, followed until 1950 by total control of prices at very low levels of only 50 to 65 percent of their former levels in both 1880 and 1938. The system of guaranteed prices between 1950 and 1965 according to Amin required France

to make excess payment over and above the world price of about 4,200 millions of CFA (West African Franc) per year. As a result of the EEC (European Economic Community), the guaranteed system ceased, to bring its prices into line with world prices.

Niane, Amadou (1980) described the Senegalese peanut industry. He discovered that from 1960 to 1970, peanut production contributed about 60 percent of the value added to the Senegalese economy. Furthermore, the export of peanuts averaged about 45 percent of the total export earnings for Senegal during the period 1969 - 1973. According to Niane the lower producer price from 1967 to 1971 together with the drought encouraged farmers to reduce investment in peanut production and to initiate a national concern for food reserve programs.

He estimated a peanut supply model as follows:

$$QGD_t = 190 + .567\ QMS_{t-1} + 2.1\ QDR_{t-1} + 29.8\ PGN_{t-1} - 66\ PF_t + .58\ RF_t$$

where

QGD_t = quantity of groundnuts (peanuts) produced in year t (in 1000 metric tons).

QMS_{t-1} = quantity of millet-sorghum produced in year t-1, (in 1000 metric tons)

QDR_{t-1} = quantity of rice domestically produced in year t - 1 (in 1000 metric tons)

PGN_{t-1} = one year lagged producer price of peanuts (FCFA/Kilo)

PF_t = price of fertilizer in the current year (FCFA/Kilo)

RF_t = amount of rainfall in year t (millimeters)

The t-statistics of the estimated parameters were (.40), (1.52), (1.42), (2.40), (-3.12), (2.7).

$\bar{R}^2 = .703$

Price elasticity of supply = $EpGN_{t-1} = 0.69$

However, in his computations, Niane considered the "official" peanut prices. The full amount of these prices are not received by farmers when they market their peanuts to the marketing board. Therefore, the "official" price is not a good indicator for measuring responsiveness of farmers.

Bela Belassa in Methodology of the Western Africa Study found an elasticity of domestic supply of 1.5 for Senegal. In addition, he found an elasticity of peanut exports of 8.0 for Senegal.

2.2 World Studies

McArthur and al. (1982) discovered that peanuts are grown abroad chiefly for their oil while peanut oil is relatively unimportant in the United States. According to the authors, during the period 1977-1979, peanut oil accounted for only about 1.5 percent of total U.S. production of edible vegetable oils. They point out that "oil stock" peanuts in the U.S. are peanuts that were rejected or diverted from edible channels. In addition, they observed that the cost of producing oil from peanuts is higher than the cost of producing oil for soybeans. For example, in 1981 the cost of producing oil per pound was 48 cents for peanuts, while it was only 15 cents for soybeans.

According to the authors, sunflower oil has been displacing a large amount of peanut oil in European markets in recent years. While the peanut acreage has remained relatively stable since the mid-fifties, the authors note that production has increased continuously due to rapidly increasing yields. They also found the total U.S. average cost of producing peanuts rose from $461.42 per acre in 1978 to $721.76 per acre in 1981. Variable costs accounted for 59 percent of total costs in 1978

compared with 62 percent in 1981; chemicals, including fertilizer, lime, and gypsium accounted for about 29 percent of total variable costs in 1981.

In analyzing the world market they found that the U.S. has emerged as the leading peanut exporter in the world. In addition, during the late seventies, U.S. peanut exports exceeded 25 percent of U.S. total peanut production compared with 5 to 6 percent of total world production that was exported. The authors also noted that world peanut oil production has averaged about 3 million metric tons per year for the last 9 marketing years (1972-1980). Finally, the authors reported that world peanut oil exports averaged about 14 percent of world peanut oil production from 1972 to 1980 with the leading oil exporters being Argentina, Brazil, and Senegal.

Burris (1976) studying the peanut supply response in Northeast Thailand came up with the conclusion that supplies of peanuts responded positively to incremental changes in their prices. In addition, he found that as the level of capital (technology, fertilizer, improved seeds) was increased, the supply functions shifted downward and to the right. In his analysis, the arc elasticities of supply at the sub-regional level ranged from 0.53 to 2.89. Furthermore, he discovered that it was possible to substantially improve net farm income by increasing peanut production at the expense of competing upland crops such as kenaf and cassava.

In 1974, Abalu determined that farmers in Northern Nigeria were price responsive and that peanut growers responses' were consistent with economic theory. He also found that although peanut farmers were price responsive, the incentive effects on peanuts vis-a-vis other crops

competing for the same productive resources was not very strong. In another study in 1975, Abalu found that the price responsiveness of Nigerian farmers was more a function of expected price than the prevailing price in the previous buying season.

Collins (1974), found that in Niger the creation by state edict of new peanut markets in rural Magaria in the middle and late 1950s benefitted producers over private companies. However, he discovered that the establishment of state control in the early 1960's over exports, producer price, and the profits of private buying companies benefitted the state at the expense of both the private buyers and the producers. In addition, attempts by the state to artificially lower producer prices were often frustrated by the factor of competition and alternative choice introduced into the marketing system as a result of nearby peanut markets in Nigeria.

Idachaba (1972) studying the effects of taxes on the sales of peanut growers in the Northern States of Nigeria found an elasticity of supply (sales) of 1.3139. He also made predictions of peanut sales to the marketing board and discovered that the predicted sales exceeded actual sales whenever the hypothetical prices were higher than actual prices.

Ihimodu (1977) analyzing the effects of the major agricultural exports and the government monopoly of their marketing in Nigeria (peanuts, cotton, palm-oil, palm-kernel) found elasticities of supplies (sales) ranging between 0.3 and 3.2.

Oni, S.A., and Olatunbosun, D. (1973) purported to test two general hypotheses: (1) there was a positive price response among the peanut growers; (2) the "a priori" reasoning that the producer price of peanuts was the major determinant of aggregate peanut production, i.e., the price

variable alone should be able to account for over 50 percent of the variability in aggregate production of this commodity. According to the authors, the producer price of peanuts is a crucial variable which policy makers should utilize in controlling and expanding the Nigerian peanut industry. An increase in the producer price of peanuts, according to the authors, could be the greatest incentive for the farmers to increase their production. They found that the prices received by farmers were usually less than 50 percent of their perspective market prices. For the authors, the bulk of the differences between the two prices arose not from transport and storage expenses associated with the peanuts but rather from direct taxes on peanut producers. The authors recommended that the various governments concerned should consider a gradual reduction, if not a gradual elimination, of all direct taxes on peanuts. Their empirical findings indicated that peanuts exhibit an inelastic supply response. Thus, the payment of higher prices to the producers would therefore not flood the market to the point of reducing the aggregate earnings from peanuts.

Owosekun, A. (1975) making some observation on the domestic crushing of peanuts in Nigeria concluded that the foreign demand for peanut oil and peanut cake was the dominating factor influencing the domestic crushing of peanuts. He found that the demand for peanuts by the oil mills was price inelastic and that the price inelasticity suggested that the sales of peanuts to the oil mills at a substantial subsidized price would not itself induce significant expansion of the industry.

Olayide, O. S. (1972) specified an export supply function of peanuts as follows:

$$Q_t = f(P_{dt-1}, P_{wt}, A_{t-1}, W_t, D_t, T, Q_{t-1})$$

where

Q_t = The quantity of peanuts supplies in any given year in thousand long tons.

P_{dt-1} = The domestic producer price with the 'appropriate' lag in LN/long ton.

P_{wt} = The current average world price of peanuts.

A_{t-1} = Acreage actually in production with the 'appropriate' lags.

W_t = Weather variable computed as an index of rainfall and humidity for the appropriate production season with due cognisance of biophysiographic crop requirements.

D_t = Index of disease variable.

T = The trend variable measured in years.

Q_{t-1} = Quantity of peanuts supplied in the last crop year as a proxy for stock adjustment.

He specified two variants of the function above. The first was the case where the world price of peanuts was not included, while the second was the case where it was included. For Olayide, this was to capture the changes in price elasticity of supply. In a third model specified as,

$$Pdt = f(P_{wt-1}, T, T^2)$$

he aimed to investigate the extent to which world price influences producer response. On the basis of the three models, three types of elasticities were estimated.

In the first model, elasticity of supply

$$E_1 = \frac{dQ}{dPd} \cdot \frac{Pd}{Q}$$

In the second,

$$E_2 = e_1 + e_2 = \frac{dQ}{dPd} \cdot \frac{Pd}{Q} + \frac{dQ}{dPw} \cdot \frac{Pw}{Q}$$

In other words, E_2 is the sum of the price elasticity of supply with respect to both the domestic and the world price of peanuts.

In the third,

$$E_3 = E_1 \cdot e_3 = \frac{dQ}{dPd} \cdot \frac{Pd}{Q} \cdot \frac{dPd}{dPw} \cdot \frac{Pw}{Pd}$$

i.e., the product of first elasticity (E_1) and that obtained from the third model.

In the first model, Olayide obtained the following supply equation.

$$Q^*_{peanuts} = \underset{(5.8969)}{10.0734} + \underset{(0.0111)}{0.00867}\ P_{dt-1} + \underset{(0.0002)}{0.00068}\ A_{t-1} - \underset{(0.0133)}{0.00475}\ W_t$$

$$- \underset{(0.2082)}{0.1795}\ T + \underset{(0.0018)}{0.00147}\ T^2$$

$R^2 = 0.8858$ Durbin-Watson = 1.879

Standard error of estimate = 0.202

From the second specification, he obtained

$$Q^*_{peanuts} = \underset{(5.8643)}{6.3862} + \underset{(0.0105)}{0.00706}\ P_{dt-1} + \underset{(0.0046)}{0.00723}\ P_{wt} + \underset{(0.002)}{0.00066}\ A_{t-1}$$

$$- \underset{(0.0126)}{0.00348}\ W_t - \underset{(0.2109)}{0.06483}\ T + \underset{(0.0018)}{0.00047}\ T^2$$

$R^2 = 0.9039$ DW = 1.991; Standard error of estimate = 0.192

From the third specification, the following equation was obtained,

$$P^*_{peanuts} = \underset{(0.2846)}{2.8055} + \underset{(0.0041)}{0.00011}\ P_{wt} + \underset{(0.0295)}{0.10333}\ T - \underset{(0.0014)}{0.00287}\ T^2$$

$R^2 = 0.6958$ DW = 1.605

$Q^*_{peanuts} = \text{Log } Q_{peanuts}$; $P^*_{peanuts} = \text{Log } P_{peanuts}$.

The figures in parenthesis are standard errors of the estimated parameters.

Finally, Olayide obtained price elasticity of export supply of (0.295) for Model 1, (0.725) for Model 2, and (0.002) for Model 3. The conclusions from his analysis can be summarized as follows:

- There was a need for better and meaningful pricing policy. This called for policies on incentives to increase production through new planting, replanting, fertilizing, and pest control schemes.
- There was an urgent need for conducive policy instruments to develop new organizational structures such as group farming, production cooperatives and community plantations that will stimulate efficient production, the pursuance of processing through agro-industrial schemes, and a meaningful bilateral trading agreement designed to facilitate market expansion for commodity exports.

CHAPTER 3

WORLD PEANUT ECONOMY

The world peanut economy is affected by changing conditions in the world economy. World trade in peanuts has declined in relative importance for various reasons.

- Existence of various oilseeds in the oilseed market that compete with peanuts (peanut oil). These oilseeds, such as sunflower, soybeans, and rapeseed have experienced substantial gains in yields in recent years. These gains, depending upon the type of oilseeds, have varied from 50 to 80 percent. In addition, in Europe, the area devoted to sunflower and rapeseed is increasing year after year.
- Worldwide crisis which brought about a reduction in the purchasing power of consumers.
- Effort to limit the increase of agricultural prices to a rate well below the inflation rate in the EEC countries (European Economic Community). According to Gaye and Andersen (1983), if this policy continues, the world peanut market will continue to be depressed for the years ahead. These authors note that peanut oil prices in the international market are heavily dependent on soybean production. Increases in soybean production are correlated with increases in soybean oil traded in the oilseed market, causing decreases in peanut oil prices. According to Gaye and Andersen (1983) bad weather experienced by Senegal in recent years brought France to search for substitutes for peanut oil such as sunflower oil, soybean oil and rapeseed oil, especially in 1980 and 1981.

Because France is the first buyer of Senegalese peanuts and peanut oil and the world's leading importer of peanuts and peanut oil, it is

understandable the substitution of other oils and fats for peanut oil by the French consumers is likely to affect Senegalese peanut and peanut oil exports. This is supported by Table 3-1 which gives the evolution of the market share for peanut oil and sunflower oil in France from 1970 to 1981. The table shows that peanut oil is loosing the importance it used to have in the French market. From 62 percent in 1970, the peanut oil market share decreased to 39 percent in 1981. At the same time the share of sunflower oil increased from 13 percent to 40.5 percent.

3.1 Production, Consumption and Trade*

3.1.1 Production

Between 1977 and 1982 world peanut production rose by 6.1 percent. When production is considered over the period, it is striking to notice how important the fluctuation is (Appendix 2, Table 2). From 16,687 thousand metric tons in 1977 world production increased by 817 thousand metric tons in 1978 before experiencing two subsequent declines in 1979 and 1980 to 16,999 and 15,916 thousand metric tons respectively. In 1981 world peanut production experienced its highest peak with 18,451 thousand metric tons before declining by 744 thousand metric tons by the crop year 1982-83. The largest peanut-producing countries for the period 1977-82 are shown in Appendix 1, Table 1. India, China, the United States, Sudan, Senegal, Indonesia led in peanut output. These countries accounted for 74 percent of total world production over the period.

Peanut oil production rose by approximately 15 percent between 1977 and 1982. The leading producing countries were India, China, Senegal,

*All data were obtained from Foreign Agriculture Circular, "Oilseeds and Products (Washington, D.C.: USDA, November 1982) unless stated otherwise

Table 3-1

Market Share of Peanut Oil, Sunflower Oil and Other Oils in France from 1970 to 1981 (percent)

Year	Peanut Oil	Sunflower Oil	Others
1970	62	13	25
1971	59	11	30
1972	59.7	12.6	27.7
1973	59.2	17.3	23.5
1974	51.5	24.6	23.9
1975	59.2	20.9	19.1
1976	57.7	23.6	18.7
1977	52.2	28.1	19.7
1978	43.8	38.3	17.9
1979	43	36.2	20.8
1980	45.1	34.9	20
1981 (estimate)	39	40.5	20.5

Source: Nielsen Secodip, Adapted from Gaye and Andersen, "Caisse de Perequation et de Stabilization des Prix. Etude Diagnostique, Tome 3, Filiere Arachide-Huile".

Sudan, and Nigeria. The group accounted for approximately 77 percent of total production.

3.1.2 Peanut Oil Consumption

World peanut oil consumption rose from 2,819 thousand metric tons in 1977 to 3,217 thousand metric tons in 1982, up 14.12 percent. This can be attributed to expanding global population, and was supported by increased production capacity of the oil mills. Peanut oil consumption followed the trend of peanut production, which means peanut production and peanut oil consumption moved together over the period 1977-82.

The largest peanut oil consuming countries are India, China, France, Sudan, Senegal, Burma and Nigeria. These countries accounted for 82.5 percent of total peanut oil consumed between 1977 and 1982. With the exception of France, it is noticeable that the developing countries of Asia and Africa are the world's largest peanut oil consumers. In contrast, peanut oil consumption is lowest in the developed countries of North American and Western Europe (with the exception of France). This can be explained by the fact that in many developed countries there are other fats and oils substitutes for peanut oil (see section degree of substitutability).

3.1.3 Trade

Because production and consumption levels of peanuts for many countries rarely are equal in any given year, a certain proportion of peanut output enters the international market. In 1977, 6.42 percent of world peanut output was traded in the international market. This figure slightly decreased to 6.25 percent in 1979. Even though world peanut production reached its peak in 1981 (over the period 1977-82), the

quantity of peanuts traded in the international market further decreased to 4.56 percent. In 1977, 15.71 percent of world peanut oil production was traded in the international market. In 1982, the percentage decreased to 11 percent. These trends reflect increasing competition from other oilseeds in the international market.

3.1.3.1 Exports. From 1977 to 1982, peanut exports declined by 96,000 metric tons, or 8.96 percent. From Appendix 2, Table 3, year-to-year fluctuations are apparent, and appear to be correlated with variations in output. The world's leading peanut exporters are given in Appendix 1, Table 2. The United States, Sudan, China, Argentina, South Africa, and Senegal, led in peanut exports. The ten largest exporters accounted for 88.5 percent of world peanut exports. The United States alone accounted for 38.13 percent.

Like the pattern for peanuts, peanut oil exports declined by 18.95 percent from 1977 to 1982. The world leading peanut oil exporters as shown in Appendix 1, Table 3 are Senegal, Brazil, Argentina, Sudan, and the United States. The group captured a market share of 68.5 percent. Senegal, the leading peanut oil exporter, captured a market share of approximately 24 percent.

3.1.3.2 Imports. Countries which are experiencing increasing demand in consumption due to population growth are obliged to import if they are not able to produce enough or if they experience production shortfalls. Western Europe, composed of France, United Kingdom, and the Netherlands, was the major peanut importer for the period 1977 - 1982. The import share was approximately 42 percent. World peanut oil imports were dominated by the EEC countries (European Economic Community)

mainly France, West Germany, Belgium, and Italy. The above countries accounted for 76.5 percent of world peanut oil imports. France, the leading peanut oil importer, captured a market share of 51 percent.

3.2 Degree of Substitutability Among Oilseeds

In this section, an attempt is made to investigate the relationships among different oilseeds to classify them as substitutes or complements. The degree of substitution prevailing among various oilseeds is indicated by their price correlation coefficients. Prices of oilseeds that can be readily interchanged in their main uses are likely to be highly correlated.

In this analysis, five oilseeds and their oil are considered: peanuts, copra, linseed, palm-kernel, and soybean. The period covered is from 1950 to 1981. The correlation matrices (Tables 3-2 and 3-3) computed show that soybeans represent the closest market substitute for peanuts given by a correlation coefficient of 0.96. Following in order are palm-kernel, linseed and copra with coefficients respectively of 0.89, 0.88, and 0.85. When the oils derived from the above oilseeds are considered, it appears that palm-kernel oil is the closest substitute for peanut oil with a correlation coefficient of 0.96. Following in order are soybean oil, linseed oil and coconut oil, with correlation coefficients of 0.93, 0.85 and 0.825, respectively.

Another table obtained from Oil World, Hamburg gives a correlation matrix of prices for selected fats and oils, computed from prices in the European market for the period 1960-1980. The fats and oils considered are soybean oil, sunflower oil, palm oil, peanut oil, cottonseed oil, rapeseed oil, olive oil, coconut oil, palm kernel oil, fish oil, butter, tallow and lard.

Table 3-2

Correlation Coefficients between International Vegetable Oil Prices.

	GOOIL	GOIL	LINOIL	PKOIL	SOIL
GOOIL	1.00	0.825	0.80	0.90	0.84
GOIL	0.825	1.00	0.85	0.96	0.93
LINOIL	0.80	0.85	1.00	0.87	0.89
PKOIL	0.90	0.96	0.87	1.00	0.94
SOIL	0.84	0.93	0.89	0.94	1.00

GOOIL = Goconut oil
GOIL = Groundnut oil
LINOIL = Linseed oil
PKOIL = Palm kernel oil
SOIL = Soybean oil

Computed from prices in world markets for the period 1960-1981.

Table 3-3

Correlation Coefficients between International Prices for Selected Oilseeds.

	CPRA	GNUTS	LSEED	PKERN	SOYB
CPRA	1.00	0.85	0.84	0.99	0.84
GNUTS	0.85	1.00	0.88	0.89	0.96
LSEED	0.84	0.88	1.00	0.85	0.89
PKERN	0.99	0.89	0.85	1.00	0.87
SOYB	0.84	0.96	0.89	0.87	1.00

CPRA = COPRA
GNUTS = Groundnuts (Peanuts)
LSEED = Linseed
PKERN = Palm kernel
SOYB = Soybean

Computed from prices in world markets for the period 1950-1981.

The figures (Table 3-4) show that soybean oil and rapeseed oil are the closest substitutes for peanut oil with a correlation coefficient of 0.97. Sunflower oil follows with a correlation coefficient of 0.96. Next comes the group including cottonseed oil, olive oil, palm oil, fish oil, lard with correlation coefficients of 0.95. The last group is composed of tallow, palm kernel oil, coconut oil, butter with correlation coefficients of 0.93, 0.88, 0.83, 0.82, respectively.

The overall conclusion that can be drawn from the analysis is that peanuts and peanut oil have serious competitors in world oilseed markets. The implication of this is the degree of vulnerability faced by a single commodity producing country like Senegal.

The degree of replacement of peanuts and peanut oil by other oils and fats can be further captured with Table 3-5 given by Gaye and Andersen (1983). It appears that in the EEC countries, consumption of peanut oil decreased over the period 1976-81 with a mean annual decrease of minus 4.0 percent. At the same time and for the same period, the world average annual decrease was minus 1.1 percent.

In contrast in both the EEC and the world, consumption of sunflower oil, rapeseed oil and soybean oil increased over the period.

Table 3-4. Correlation Matrix of Prices for Selected Fats and Oils in European Markets

	Sunflower Oil	Peanut Oil	Cottonseed Oil	Rapeseed Oil	Olive Oil	Palm Oil	Coconut Oil	Palm Kernel Oil	Fish Oil	Butter	Tallow	Lard
Soybean Oil	0.99	0.97	0.98	0.99	0.93	0.96	0.86	0.90	0.96	0.78	0.93	0.94
Sunflower Oil		0.96	0.98	0.98	0.92	0.93	0.85	0.88	0.95	0.75	0.90	0.92
Peanut Oil			0.95	0.97	0.95	0.95	0.83	0.88	0.95	0.82	0.93	0.95
Cottonseed Oil				0.96	0.92	0.93	0.88	0.89	0.93	0.98	0.91	0.92
Rapeseed Oil					0.93	0.97	0.87	0.91	0.97	0.80	0.93	0.96
Olive Oil						0.93	0.78	0.84	0.31	0.91	0.95	0.96
Palm Oil							0.90	0.95	0.96	0.86	0.97	0.98
Coconut Oil								0.99	0.86	0.69	0.89	0.85
Palm Kernel Oil									0.90	0.75	0.92	0.91
Fish Oil										0.80	0.94	0.96
Butter											0.90	0.91
Tallow												0.98

Computed from Prices in the European Markets for the Period 1960-1980.

Source: Oil World, Hamburg.

Table 3-5. Evolution of Oil Consumption in Europe and the World.
(000 metric tons)

		Oct/Sep 76/77	Oct/Sep 77/78	Oct/Sep 78/79	Oct/Sep 79/80	Oct/Sep 80/81	Oct/Sep 81/82*	Mean Annual Variation (%)
Peanut Oil	EEC	488	428	425	445	338	381	-4.0
	World	2756	2547	2682	2741	2379	2569	-1.1
Rapeseed Oil	EEC	418	233	513	530	737	691	+22.4
	World	2730	2733	3319	3353	4141	4435	+10.6
Sunflower Oil	EEC	535	742	831	880	921	873	+11.2
	World	3599	4268	4620	4962	5176	5255	+ 8.0
Soybean Oil	EEC	1669	1890	1856	1950	1938	2050	+ 4.3
	World	9521	10751	11860	12415	13240	14008	+ 8.1

*Source: Oil World

Adapted from Gaye and Andersen.

Table 3-6. Principal Oilseed Producing Countries

Type of Oilseed	Industrial Countries	Developing Countries	Centrally Planned Economies
Soybean	United States	Argentina, Brazil, China	
Coconuts		India, Indonesia, Philippines, Sri Lanka	
Cottonseed	United States	Argentina, China, India, Pakiston, Peru, Turkey,	USSR
Peanuts	United States	China, India, Nigeria, Senegal, Sudan	
Sunflower Seed		Argentina, Turkey	USSR, Bulgaria, Romania
Oil Palm		Indonesia, Ivory Coast, Malaysia, Nigeria, Zaire,	
Rapeseed	Canada, France	China, India	Poland
Sesame Seed		China, Ethiopia, India	

Source: Adapted from UNIDO, draft world-wide study on the vegetable oil and fats industry: 1975-2000, UNIDO/I cis. 46, September, 1977.

CHAPTER 4

SENEGALESE PEANUT ECONOMY

4.1 Relative importance to the economy

The peanut industry plays a very important role in the Senegalese economy. It provides income and employment to the agricultural sector. It represents a valuable source of foreign exchange earnings. And the peanut oil produced from peanut serves the domestic consumer market. The value of exports of peanuts and peanut oil amounted to 40 billions CFA Francs in 1975, 15.3 billions in 1973 and 34 billions in 1974 (Centre Senegalais du Commerce Exterieur, 1978). In percentage terms, the peanut and its derivatives provided 41 percent of the total Senegalese earnings in 1975. However, the relative importance of peanuts in the Senegalese economy is decreasing over time. In fact, from 83 percent of total earnings in 1961, peanut earnings increased to 98 percent in 1970 before declining to 41 percent in 1975.

4.2 Peanut Production and Marketing

Introduced in Senegal at the beginning of the 18th century by some slave merchants coming from Brazil, the peanut was first considered as a subsistence crop. It is only from 1830 that peanut production became relatively important and began to occupy a preponderant place in the economy of the country. From 5,000 metric tons in 1854, annual peanut production reached 125,000 metric tons in 1902 and 1907 before amounting to 232,000 metric tons between 1910 and 1915. From 1925 to 1930, the average production traded averaged 458,000 metric tons, and further increased to 600,000 metric tons by 1937. Until then and up to the accession of the country to independence, the quantity of peanuts traded

through official channels had been relatively stable at approximately 500,000 metric tons. After independence, peanut trade averaged 963,000 metric tons between 1963 and 1968. After this period, the country began to experience heavy fluctuation in production due to erratic rainfall. Average production declined to 827,000 metric tons between 1968 and 1980.

Peanuts are produced in all regions of Senegal. The major producing regions are:

Sine-Saloum region which produced 45.38 percent of total peanut production for the period 1960 to 1980. Other regions and percentage of total production are:

Louga-Diourbel	23.72 percent
Thies	13.01 percent
Casamance	12.98 percent
Senegal-Oriental	4.18 percent
Capvert and Fleuve	0.73 percent

The three leading regions are called the peanut belt, and together accounted for 82 percent of total peanut production over the period.

Since Senegal acceded to independence (1960) peanut marketing has been subject to various innovations. Prior to 1960, most of the peanut production was marketed by French companies such as Maurel and Prom, Deves and Chaumet assisted by Lebanese middlemen. At that time a very little volume of peanuts was marketed through the cooperative system encouraged by colonial authorities.

In 1960, a government regulation established the creation of the present cooperative system. The functions of the cooperatives were to be restricted to three related areas: provision of credit, supply of agricultural implements and other materials, and marketing of members'

produce. Supplies and sales involved all members on an individual basis and the existing conditions of agricultural production were not directly affected (Donal O'Brien Cruise, 1975).

The proclaimed purpose of the cooperatives was to end exploitationary effects of the colonial marketing system, which had maintained farmers in semi-permanent indebtedness (Donal O'Brien Cruise, 1975). However, cooperatives officials, nominally elected but effectively often chosen as local notables by the government, were in a position to turn the institution to their own economic purposes (Schumacher, 1975; Donal O'Brien Cruise, 1975).

The cooperative movement experienced a very rapid diffusion. A total of 679 cooperatives had been established by 1961, and by 1965 the number reached 1563.

In 1961, a public agency, the Office de Commercialization Agricole (OCA) was created for the marketing of peanut production. The purpose of OCA was, essentially, to purchase peanuts from the producers and sell to the oil mills. In 1966 a government regulation gave birth to the ONCAD (Office Nationale de Cooperation et d Assistance au Developpement) marketing board. This public agency was provided with a capital of 2.14 billion CFA francs (approximately $8,669,000)(Sow, P. 1983).

In 1967, the monopsony in peanut purchasing at the producer level was attributed to ONCAD which marketed the peanut produce collected from cooperatives to a newly created public agency (1967) the Office de Commercialization Agricole du Senegal (OCAS) which replaced the old OCA.

OCAS was responsible for the sale of unshelled peanuts to local oil mills under a quota fixed before each crop year in relation to mill needs and crop forecasts. In turn, the oil mills were responsible for oil

sales while OCAS exported the remaining crop in the form of shelled peanuts (Sow, 1983).

However, ONCAD started assuming the OCAS' role in the crop year 1971-1972. In addition to the functions of collecting and marketing the peanut produce, the ONCAD marketing board was responsible for the training of cooperative officers and members, the acquisition and distribution to cooperatives of inputs (fertilizers, equipment, pesticides, seed). Throughout the years, the relationship of ONCAD to cooperatives was beset with problems, specially in provision of inputs, and debt repayment, so that the government in 1979 decided the reform of the cooperative system with the following features:

- Regrouping the cooperatives into larger, more economically viable units.
- Establishing associations of farmers within a limited area with voting representation in the new larger cooperatives.
- Linking the cooperative structure with the ongoing administrative reform in rural communities.
- Shifting much of the responsibility for control of credit and inputs for food crops from ONCAD to the research development extension agencies working with cooperatives.
- Developing at each cooperative center a complex including a seed warehouse, storage area for peanuts (SECCO), weighing station, conference hall and storage for inputs and central collection for farm produce for delivery to regional warehouses.

Subsequently, the government decided in September 1980 to liquidate the ONCAD marketing board because of continuous management inefficiencies and worsening economic and social conditions for farmers. The Societe

Nationale de Commercialization des Oleagineux du Senegal (SONACOS) created in 1975 became the intermediary between peanut producers and the oil mills. The Societe Nationale d'Approvisionnement du Monde Rural (SONAR) took over the role of coordinating and providing seed to rural farmers.

4.3 Peanut Oil Production and Marketing

The first evidence of producing oil in Senegal goes as far back as the 19th century. It was in 1833 that Benjamin Jaubert living in Goree Island showed the first sample of oil he made (BCEAO).

In 1920 the proclaimed aim for the oil mills was only to meet local needs. This was estimated at 3,000 metric tons per year. Two types of peanut oil are extracted by the oil mills:

- raw peanut oil and
- refined peanut oil.

Peanut oil production is subject to fluctuations in peanut production.

The process of extraction is as follows:

- After being controlled, regarding both the weight and the quality of the grain, peanuts arriving at the oil mill are first cleaned.
- The shelling is the second step. The shells are used to produce energy such as electricity for the oil mill.
- The grains which contain 50 percent of their weight in oil equivalent are then crushed. This can be done either by double pressing or by the combination of pressing and extraction. For either method, after the pressing, the oil is filtered twice. The product is then called raw peanut oil.

Raw oil contains numerous substances. Oil refining consists of eliminating all the foreign substances except minerals and vitamins.

The marketing of peanut oil is carried out by the SONACOS (Societe National de Commercialization des Oleagineux du Senegal). Before the liquidation of the ONCAD marketing board, the agency purchased the peanut produce from ONCAD and distributed it to the oil mills for crushing.*

4.4 Peanut Utilization

4.4.1 Domestic Peanut Oil Consumption.

Peanut oil is relatively important in the Senegalese dietary system. From 1961 to 1981 domestic peanut oil consumption doubled from 26,697 metric tons to 58,000 metric tons. This growth in consumption reflects rising population and income levels in the last decade. Because of the fact that between 1961 to 1981 peanut production decreased, the increase in peanut oil consumption has meant a more rapid increase in the percentage of the crop directed to this form of utilization.

4.4.2 Peanut Oil Exports

The exportation of peanut oil began in 1927 and reached a peak of 4122 metric tons in 1930. The importing countries were mainly those of North Africa. In 1936, peanut oil exports were 2,071 metric tons; exports reached 5,302 metric tons in 1937 and 5669 in 1938. In 1947 there were ten oil mills in Senegal, however, between 1953 and 1958, some of the oil mills disappeared because of heavy competition. In 1972, only five oil mills remained.* The FAO figures (FAO trade yearbook) show that

*With the exception of the SEIB oil mill which bought and crushed its own grains.

*These were PETERSON and Co., LESIEUR-AFRIQUE, SODEC, SEIB, SEIC. The first two oil mills were located in DAKAR. SODEC was located in SINE SALOUM region. SEIB was located in DIOURBEL region and SEIC in CASAMANCE region.

peanut oil exports decreased between 1960 and 1980, from 114,086 metric tons to 73,794, down by 35 percent. However, except in 1971, 1973, 1978 and 1980, annual peanut oil exports have exceeded 100,000 metric tons. In 1972, 1976, 1977 exports exceeded 200,000 metric tons. The downward trend in peanut oil exports can be attributed to irregularity in weather and unstable market conditions. From 1960 to 1970 the volume of Senegalese peanut oil exports was relatively stable because Senegal was given absolute quotas by France. However, with the accession of France in the EEC, Senegalese peanut oil exports were subject to world market regulation. This explains the heavy fluctuation in peanut oil exports after the 1960's. At present, four oil mills exist in Senegal. LESIEUR, SODEC, SEIC all of which are under the control of the SONACOS plus SEIB. The oil mills are able to crush up to 925,000 metric tons per year.

4.4.3 Peanut Exports. Peanut exports exhibit a pattern similar to that of peanut oil exports. From 1960 to 1968 peanut exports were relatively stable (362,003 metric tons to 347,149 metric tons) because of the trade preferential that Senegal received from France. Under this system, Senegal benefited from a price set at 52.50 CFA francs per kilogram of shelled peanuts, while the average world price was around 46 CFA francs (Sow, 83). According to Amin (1974), under the preferential regime, France made an excess payment over and above the world price of about 4200 million CFA francs (see Chapter 2).

4.5 Price Policy

"One striking feature of the stock of price information available in the Sahel is the rarity of "actual"; the bulk of such systematic price data as exists consists of "official" prices and rates. This means we

are almost always looking at price realities through a screen. Put another way, we are forced to look mostly at proxies for "actual" prices. This, in turn, means that perceptions are necessarily distorted and we almost never can be sure by how much!" Elliot Berg. Cred U. of Michigan (1977).

When looking at the peanut producer prices for Senegal, one should distinguish between "official" and "actual" producer prices. In fact, the price officially announced is not received in full by farmers when they market their crops through official channels. A certain rate called anti-fraud withholding is kept in the Senegalese Development Bank. This is supposed to be freed as refund to the producers at the end of the official crop marketing season after verification, quality control, and rehandling resulting from it and not imputable to managers (peseurs) and cooperative presidents involved in fraud.

The anti-fraud rate has varied depending upon the crop season and the nominal producer price. Unfortunately, none of the previous studies available took this difference into consideration when performing their analyses.

Almost always "official" prices are considered, and when used to estimate supply equations may tend to bias the results by failing to reflect the real situation. Thus, three fundamental questions can be subject to investigation:

1. Is it possible to compute "actual" producer prices, i.e., prices paid to farmers when they market their crops to the ONCAD marketing board?

*BCEAO: West African Central Bank regrouping Senegal, Ivory Coast, Benin, Togo, Upper Volta, Niger.

2. Why the government, while setting an "official" producer price is paying an "actual" price less than the former?
3. How agricultural prices in general, and peanut prices in particular, are determined?

The answer to the first question is straight-forward. In fact, the BCEAO* monthly journal gives the different anti-fraud withholding for various years. Table 4-1 gives the different rates and the nominal producer prices of peanuts. It appears from the table that the anti-fraud withholding has varied from 3.61 percent to as much as 10 percent in 1980.

It is important to underline that from 1960 to 1970, three different prices were established for the country as a whole. However, from 1970 onward a single producer price prevailed throughout the country. In order to compute the nominal producer prices for years in which different prices prevailed, we made an assumption by taking the average of the three different prices. The real (actual) producer price was obtained by subtracting the amount covered by the anti-fraud withholding to the "official" or nominal producer price.

For the second question, the rationale for the government was to challenge farmers to improve themselves. In other words, responsibility was given to the cooperatives to manage themselves in such a way that there will not be any fraud that could prevent them from getting back the anti-fraud withholding. Unfortunately, this management went beyond the control of individual farmers. In fact, each cooperative or group of farmers was expected to higher a weigher or "Peseur" who, in effect, served as the secretary-treasurer of the association. The weigher was chosen for his ability to read, to write and do elementary calculations.

Table 4-1

Rate of Anti-fraud Withholding
and Nominal Producer Price

	RAFW (percent)	Nominal Producer Price (CFA Francs/Kg)
1960	5.0	22.00
1961	5.0	22.00
1962	5.0	22.00
1963	5.0	22.00
1964	5.0	22.00
1965	5.0	22.00
1966	5.0	22.00
1967	5.0	17.67
1968	5.0	17.67
1969	5.0	17.67
1970	4.36	18.85
1971	4.76	23.10
1972	4.76	23.10
1973	5.88	25.50
1974	4.11	36.50
1975	3.61	41.50
1976	3.61	41.50
1977	3.61	41.50
1978	3.61	41.50
1979	5.49	45.50
1980	10.0	50.50

Source: BCEAO Journal, various issues.

RAFW = Rate of anti-fraud withholding.

For all the services, a commission fixed by ONCAD marketing board was received by the weigher. In addition, the weigher was allowed a wastage tolerance of 0.75 percent of the total produce collected and was obliged to pay out of his commission the value of any "secco loss" exceeding that threshold (Schumacher, 1975). If the weigher's commission could not cover the loss, the anti-fraud withholding would have to cover it. Because of the reasons above, the weighers (sometimes in connection with the cooperative presidents) were known to engage in fraudulent practices.

a. Cooperative presidents and weighers were known to transmit to administrative officials fictitious receipts for debt payments in order to obtain an early release of purchasing funds to be used for speculative purposes (Schumacher, 1975).

b. The weighers often times falsely recorded the amount of peanuts collected by the cooperatives by deducting an excessive amount of the weight of the sacks containing the peanuts delivered by each farmer (Schumacher, 1975).

c. The weighers were also known to add sand to the grain collected by the cooperatives before it was weighed prior to evacuation from the SECCO* (Schumacher, 1975).

All of these practices served to justify the government action of not paying the official price. At the same time farmers were penalized by forcing them to pay for frauds they did not commit themselves.

Concerning the third question, according to Gaye and Andersen (1983), the official producer price of peanuts is fixed by a government regulation at the beginning of each crop season. The committee involved is composed of representatives from

*SECCO: place where the peanuts are stored.

- the oil mills,
- the price stabilization bureau called the "Caisse de Perequation et de Stabilisation des Prix",
- the Senegalese Development Bank,
- other related ministries.

One thing is obvious. The peanut prices are designed to be internally market clearing but producer prices are set too low. This, however, is not always bad. In fact, following John Mellor (1966), in the early stage of development, farmers may be taxed justifiably through low agricultural prices in order to stimulate development of the non-agricultural sector. However, as development gets underway, the amount earlier taken from the agricultural sector should come back to the sector in the form of irrigation, improved health, improved transportation... According to Gaye and Andersen (1983, p. 212), the adverse trend for prices paid to producers and the peanut oil prices in the international market brought about the financial deficit in the peanut sector. The findings of this study do not confirm such conclusion. In fact, even though nominal producer prices of peanuts have increased substantially, the findings of this study (Chapter 9) indicate that in real terms farmers were better off in the early 1960's than nowadays.

The failures experienced in the peanut industry are more of a problem of efficiency in management than the fact that farmers are paid higher nominal prices. Furthermore, the problems in the world peanut market have arisen only in recent years. Through the 1960s, the ONCAD marketing board gained substantial surplus under a system of low agricultural prices to producers while world peanut prices were favorable. Instead of being used to support modernization and increased

productivity in the rural sector, the surplus was mostly absorbed into costly services, state enterprises, and civil services (Rita Cruize O'Brien, 1979). For the oil mills, the difficulties are more of a function of subsidized domestic peanut oil prices than the world peanut oil prices (see Chapter 6).

CHAPTER 5

THEORETICAL FRAMEWORK

Many commodity studies involve demand and supply analysis and most of them are directed toward finding important implications related to the policy-making process. In the country level, peanut supply response studies may be undertaken to determine how government programs such as fertilizer subsidy or price support programs and relative profitability among competing crops affect production decision. Studies of peanut and peanut oil demand may be undertaken to determine the future growth of peanut oil consumption under various levels of income and population. Therefore, a brief review of supply and demand theory and the factors affecting them is in order.

5.1 Supply Theory

Tomek and Robinson (1981) define supply as "how much of a given commodity will be offered for sale per unit of time, as its price varies, other factors held constant."

Furthermore, they state that six principal factors affect the supply relationships. These are the following:

1. Changes in factor prices.
2. Changes in the profitability of substitute commodities.
3. Changes in technology which influences both yields and costs of production and/or efficiency.
4. Changes in the prices of joint products.
5. Institutional constraints.
6. Changes in production due to weather, diseases and insects.

In the Senegalese setting, the above factors can be specified as follows:

1. Peanut price. Prices anticipated or received can shed light to the degree of responsiveness of farmers. There is no longer doubt as to whether or not African farmers are responsive to prices. Recent empirical studies have shown a positive price response of agricultural production in developing countries (Bateman, 1965; Dean, 1965; Oni, 1969). However, in the Senegalese case the fundamental questions that arise are which kind of price influences the supply of peanuts? Is it the nominal producer price or the real producer price, in other words, the price actually received by farmers deflated by the consumer price index (CPI)?

Another pertinent question is what is the most suitable proxy affecting farmers' production decisions, expected or lagged producer prices?

2. Acreage. As noted in earlier sections of this study, most agricultural production in Senegal comes from small family farms. Because of the traditional methods of cultivation that prevail which tend to limit yield per unit area, any attempt to increase production is almost always accompanied by an increase in acreage (land extensive methods).

3. Production costs. The concept of cost is very important in the production process. Two categories are involved in the production process, fixed costs and variable costs.

Fixed costs are those costs that do not change when the volume of production changes. Examples for the peanut case in Senegal include depreciation and repairs. Variable or operating costs are those costs

which vary when volume of production changes. Examples include expenses for fertilizer, seed, insecticides and herbicides.

4. Government policies. Government intervention in agricultural production is very important. Such an intervention can be of the form of input subsidies, farm price supports, subsidized credit, etc.

In the Senegalese case, the government, through ONCAD development agency, has undertaken vast development programs in the peanut sector. The program called the "programme agricole" was implemented in the late sixties. The "programme agricole" can be defined as the equipment policy (including seeds and fertilizer) for farmers belonging to cooperatives as determined by the government. There are six major steps to the "programme agricole".

a. Determination of the debt capacity of the cooperatives. Up to 1978, for each cooperative or group of farmers, one-fourth of the average of the three last peanut marketing seasons was considered minus the total cooperative debts for the year under consideration and minus 25 percent of the total debts of the cooperative. Then 70 percent of the value thereby obtained were allocated to the productive short run, i.e., fertilizer, seed, 20 percent to the medium term, i.e., equipment and 10 percent to the short term non-productive, i.e., millet.*

From 1978 to 1980, before the suppression of the ONCAD marketing board, the determination of the debt capacity took into account one-third of the average of the last three peanut marketing seasons minus the total debts for the year under consideration and minus 25 percent of that same total debts. Unlike the system that formerly prevailed, the cooperatives

*It was called non-productive because it was a subsistence credit.

under this setting had the right to provide their own repartition, in other words what percent would be allocated to the short and medium terms.

b. General meetings for the cooperative members. In this step every member expresses his needs and the president of the cooperative makes decisions by considering the different marketing turnovers. To obtain a larger loan, therefore, a producer has to increase his peanut production and market it through the cooperative.

c. Publication of documents. At this step, all demands of the cooperatives are written in a document called the regional document.

d. Meetings of the regional committee. Committees are composed of the regional governor, some agricultural technicians and the local representative of the Senegalese Agricultural Development Bank (BNDS). Each committee has the last word whether to accept or reject the orders of the cooperatives in the region based on the debt capacity.

e. Transfer of the different regional documents to the national level.

f. The distribution of the equipment and the signature of the "accusé de réception" end the "programme agricole" process. The "accusé de réception" is a juridique document that is given by the Senegalese Agricultural Development Bank and which the president of each cooperative signs proving he has received the exact number of farm machines and quantity of fertilizer bags and seeds mentioned on that "accusé de réception". As indicated, the short term credit covered fertilizer and seed. It was supposed to be paid back shortly after harvest. The medium term loan covered agricultural equipment, specifically "ariana," "arara," "houe sine", "polyculteur". Each farmer receiving one of the above has a

commitment to pay one-fifth of the equipment value each year for five years.

5. Technology. One of the implications of an improved technology is a shift in the entire production function with a corresponding increase in production efficiency. Among the recent technological changes in the Senegalese peanut production are improved varieties developed by the plant breeders, increased fertilizer use per hectare, improved machinery such as "ariana", "polyculteur".

6. Weather conditions, crop diseases. In most countries, especially the developing ones, because of a lack of financial resources for irrigation purposes, agricultural production is very dependent upon the amount of rainfall. The more it rains, the more production is likely to increase ceteris paribus. Disease control influences both quantity and quality of production.

5.2 Demand Theory

Distinction should be made between consumer demand and market demand. Tomek and Robinson (1981) define consumer demand as the various quantities of a particular commodity which a consumer is willing and able to buy as the price of that commodity varies, with all other factors affecting demand held constant. They state that demand relation simply defines the pure relationship between price and the quantity purchased per unit of time while holding other factors constant.

According to the authors distinction should also be made between static and dynamic aspects of demand. The static concept of demand refers to movements along a demand curve. This is then called a change in the quantity demanded. The term dynamic may refer to changes in

demand which are associated with changes in income, population or other pertinent variables affecting demand and which occur with the passage of time.

Market demand is defined in terms of the alternative quantities of a commodity which all consumers in a particular market are willing and able to buy as price varies and as all other factors are held constant. Several factors may affect the level of demand.

1. Population. Demand and population size are positively related. In other words, increases in demand, both in the aggregate and for the individual products, are closely linked to the rate of population growth.

2. Prices. In accordance with economic theory of consumer behavior, it is hypothesized that quantity of peanut oil demanded varies inversely with the price of peanut oil. In other words, people would buy more peanut oil at lower prices than they would at higher prices. Anytime this law does not hold, the commodity or product is called a giffen good. In the Senegalese case peanut oil can be considered as a normal good. For that reason it is fruitful to investigate the variations in the quantity of peanut oil purchased when its price varies. This idea or the concept of price elasticity of demand is defined as a proportional change in the consumption of a given commodity with a given change in the price of the commodity. If the change in consumption is less than proportional to the change in price, then the demand is said to be inelastic. Numerically it refers to a figure less than unity in absolute terms. If the change in consumption is greater than proportional to the change in price, the demand is elastic (greater than unity in absolute terms).

3. Prices of substitutes. Theoretically, until recently, there were no direct substitutes for peanut oil in the Senegalese economy. It is only recently that the oil mills have become involved on a significant scale in the transformation of soybeans and sunflower seed for local vegetable oil consumption. In general, whenever substitute commodities for one particular product exist, one can speak of a cross elasticity of demand. This purports to portray the proportional change in the consumption of a commodity with a given change in the price of another commodity. The cross elasticity of demand will be high if the two commodities are close substitutes. The cross eslasticity will be low if the degree of substitutability is not very great.

4. Consumer income. For many agricultural products it is expected that income and demand have a positive relationship. However, for some commodities the inverse relationship prevails, so that the concept of inferior goods comes to play. Peanut oil in Senegal is in the first category, that of a normal good.

The concept of income elasticity of demand is defined as a proportional change in the consumption or purchases of a commodity with a given change in the income of the consumer.

5. Consumer behavior and consumer preference. Following Tomek and Robinson (1981), changes in tastes and preferences contribute to shifts in the demand for agricultural commodities, although their effects are often difficult to isolate because they appear to be associated with changes in income or other variables.

5.3 Data Collection

5.3.1 National, Official and Regional Supplies

All the data with the exception of domestic prices of peanuts were obtained from the Ministry of Rural Development.

5.3.2 Peanut Exports

The quantities of peanuts traded by farmers through official channels were collected from the Ministry of Rural Development. Domestic prices of peanuts were obtained from the BCEAO journal, various issues. The export prices of peanuts were derived from Pierre Thenevin and J. M. Yung report "Evaluation De La Filiere Arachide Au Senegal". The peanut exports data were obtained from the FAO Trade Yearbook by examining various issues. For some years, in addition to the quantity of unshelled peanuts traded, there existed quantity of peanuts exported in shelled form. For those years conversion was made to unshelled peanut equivalent by using an appropriate shelling ratio based on the Foreign Agricultural Circular: Oilseeds and Products, USDA.

5.3.3 Peanut Oil Demand

The quantity of peanut oil demanded from 1961 to 1976 was obtained from the BCEAO Journal, various issues. This was completed up to 1981 by looking at the Foreign Agriculture Circular: Oilseeds and Products (USDA), various issues. For the domestic price, the BCEAO (West African Central Bank) Journal No. 207 of June 1973 states that from 1961 to 1973 the price of peanut oil (one liter) was set at 98 FCFA by a government regulation. In other words, domestic price of peanut oil was subsidized by the state during that period. The prices from 1975 to 1981 were obtained from Gaye and Andersen report "CPSP Tome 3 Filiere Arachide - Huile".

As an estimate of the 1974 price, we assumed it was not different from 1973 price, i.e., we assumed that the same price prevailed for the two years. Population and income data were obtained from "Groupe Macroeconomique De Planification" of the Ministry of Plan.

5.3.4 Peanut Oil Exports

The quantities of peanut oil exported were obtained from the FAO trade yearbook, various issues. The Gaye and Andersen report (1983) gives the ratio of refined peanut oil to unshelled peanuts for 1979, 1980, 1981. Peanut oil production was based on that ratio by considering the average of [the ratios of] the three years above as a basis in performing the computations. This however, was done after deducting the quantity of unshelled peanuts exported from the quantity of peanuts traded through official channels. Domestic peanut oil prices were obtained from the peanut oil demand model. Peanut oil export prices were obtained from Pierre Thenevin and J. M. Yung report "Evaluation De La Filiere Arachide Au Senegal". Like the peanut exports prices, peanut oil exports prices were expressed in C.I.F. In order to obtain the FOB prices the Gaye and Andersen calculations were followed. That is to subtract 9.5 CFA francs from the CIF price per kilogram.

5.4 The Econometric Model

5.4.1 Review of the basic regression analysis

Part of this review will be patterned after Lita Pabuayon (1983). A brief overview of the Ordinary Least Squares (OLS) method and its eventual limitations follows.

The basic multiple regression model can be expressed as:

$$Y_t = \alpha + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \ldots + \beta_K X_{Kt} + \varepsilon_t \qquad (*)$$

where

Y_t = dependent variable

α = intercept = value of Y when all independent variable are set to zero.

β_K = unknown parameter associated with Kth independent variable.

X_K = K^{th} independent variable.

ε = error or disturbance term.

t = t^{th} observation, t = 1, 2 ... T

The assumptions of the model are (Maddala 1977, page 75):

1. The error term has mean zero and a common variance for all t. In other words,

$E(\varepsilon_t)$ = Expected value of ε_t = 0 for all t

$V(\varepsilon_t)$ = Variance of (ε_t) = $E(\varepsilon_t^2)$ = σ^2 for all t.

2. The errors are uncorrelated, i.e., ε_t and ε_s are independent for any t and s observations given by $E(\varepsilon_t \varepsilon_s) = 0$, for $t \neq s$.

3. The explanatory or independent variables are non-stochastic and no exact linear relationship exists between two or more independent variables.

4. The errors have a normal distribution with mean zero and variance σ^2, in other words

$$\varepsilon_t \sim N(0,\sigma^2)$$

Given the linear form of the model as in (*), the least squares estimators of α and β under assumptions (1) through (3) are BLUE (Best Linear Unbiased Estimators). Assumption (4) is necessary in order to perform confidence interval statements and apply statistical tests.

The least squares estimators, $\hat{\alpha}$ and $\hat{\beta}_K$ are obtained based on the least squares criterion which states that $\hat{\alpha}$ and $\hat{\beta}_K$ must be chosen in a manner that minimizes the sum of squared errors defined as

$$SSE = \sum_{t=1}^{T} \hat{\varepsilon}_t^2 = \sum_{t=1}^{T} (y_t - \hat{y}_t)^2$$

where $\hat{y}_t = \hat{\alpha} + \hat{\beta}_1 X_{1t} + \hat{\beta}_2 X_{2t} + \hat{\beta}_3 X_{3t} + \ldots + \hat{\beta}_K X_{Kt}$ (**)

SSE measures the variation in the dependent variable not accounted for by the regression equation.

SSR = variation in y explained by the regression equation is equal

$$\sum_{t=1}^{T} (\hat{y}_t - \bar{y})^2$$

The total variation in y about its mean is given by

$$SST = \sum_{t=1}^{T} (y_t - \bar{y})^2 = \sum_{t=1}^{T} (y_t - \hat{y}_t)^2 + \sum_{t=1}^{T} (\hat{y}_t - \bar{y})^2 = SSE + SSR$$

Thus R^2 or the coefficient of determination is equal

$$R^2 = \frac{SSR}{SST} = 1 - \frac{SSE}{SST}, \text{ where } 0 \leq R^2 \leq 1$$

The coefficient of determination gives the proportion of the total variation in the dependent variable explained by the explanatory variables included in the regression model.

From equation (*) $\hat{\beta}_i = \frac{\partial y}{\partial X_i}$, i = 1, 2 ... K

It is the partial derivative of y with respect to the corresponding explanatory variable provided that the other variables are held constant. The individual $\hat{\beta}$'s can be tested by the t statistic, i.e.

$$\frac{\hat{\beta} - C}{\text{standard error } (\hat{\beta})} \sim t_{T-K} \text{ degree of freedom (df)}$$

where C = 0 under the null hypothesis that the explanatory variable associated with β does not affect the dependent variable.

When the computed t exceeds the critical t- value at the chosen level of significance, the null hypothesis that $\beta=0$ is rejected. Otherwise there is insufficient evidence to reject the null hypothesis. Furthermore, confidence intervals can be established for individual estimated parameters. Thus a$(1 - \alpha)$ 100% confidence interval about βi is given by

$$\hat{\beta}i - t\alpha/2\ (v) \cdot \text{standard error}\ (\hat{\beta}_i) \leq \beta_i \leq \hat{\beta}_i + t\alpha/2\ (v) \cdot \text{standard error}\ (\hat{\beta}_i).$$

where

$t\ \alpha/2$ = tabulated value of t-distribution at the level of significance α.

v = the corresponding degrees of freedom = degree of freedom associated with the error.

The overall significance of the estimated regression, (i.e., whether y is linearly related to all explanatory variables included in the model) can be tested via an F-test given by

$$F_c = \frac{SSR/(K-1)}{SSE/(T-K)} = \frac{R^2/(K-1)}{(1-R^2)/T-K)}$$

under the null hypothesis that all the true parameters are zero simultaneously, in other words, $\beta_1 = \beta_2 = \beta_3 = \ldots\ _K = 0$

However, since time series data will be used for the present study, some possible limitation of the Ordinary Least Squares could be multicollinearity or autocorrelation.

Multicollinearity

As stated earlier, one of the requirements of the use of the OLS procedure is that the explanatory variables be independent of one another. When the opposite situation occurs, i.e., when the explanatory

variables are linearly dependent and, hence, can be expressed as linear combinations of one another the situation is called multicollinearity.

Practically, multicollinearity can be detected when there is a high F-statistic meaning that the overall estimated regression is significant while the individual parameters have small t-statistics.

Solution

1. Variable deletion. While dropping a variable may resolve the multicollinearity problem, the general result is misspecification of the model and biased estimation if the variable is an important one.

2. Restrictions. A second alternative is to impose restriction on a value of a coefficient or some combination of regression coefficients. However, there will be biased estimates if the restriction is not true.

3. Attempt to reduce the variance of the errors (σ_ε^2). Here there are two possibilities

   a. Try new functional form to reduce the noise (variance of the errors);

   b. add new variable(s).

4. Ridge Regression. This technique creates biased parameter estimates that are supposed to have smaller mean squared errors than the Ordinary Least Squares estimates (Peter Kennedy, 1979).

Autocorrelation

This occurs if the errors are not independent so that the off-diagonal elements of the variance-covariance matrix are non-zero contrary to the classic regression assumption.

Solution

1. The Cochran-Orcutt iterative procedure.
2. The Hildreth-Lu method.

5.4.2 Domestic Supply for Peanuts

Two supply models have been hypothesized: a) A national supply model based on total peanut production, and b) an official supply (sales) model based on the official quantity traded by farmers through the ONCAD marketing board. For both models, the supply functions have been hypothesized to be influenced by rainfall, acreage, the quantity of seed available, the quantity of millet sorghum produced lagged one year, a time trend, and the price of peanuts. The relevancy of the price of peanuts, acreage, rainfall in influencing the supply functions was discussed earlier in this chapter. The justification for the other variables is as follows.

Quantity of millet-sorghum produced lagged one year is hypothesized to be an important variable influencing how many hectares farmers will devote to other crops and particularly peanuts. It is likely that if the farmer has a good millet-sorghum harvest last year, he will maintain at least the same amount of land for peanut production the following year.

Seed availability could substantially increase production, especially if it is improved seed like the Senegalese government has done through the ONCAD marketing board since the 1960's.

Time trend will account for the variables for which we could not get any estimates because of data limitation. For example, labor, machinery...

Nevertheless, the consideration of all the explanatory variables above is only theoretical. This does not mean all of them will necessarily enter the best model that will be selected.

The model selection procedure will be mainly based on the all possible regressions method or procedure RSQUARE in SAS (Statistical Analysis System), the backward elimination procedure, the stepwise procedure, and the t-directed search technique.

a. All Possible Regressions

This procedure is a rather cumbersome one and is quite impossible without access to a high-speed computer. Thus, it has come into use only since fast computers have become generally available. (Daper and Smith 1981).

b. The Backward Elimination Procedure

This begins with the largest regression, using all variables, and subsequently reduces the number of variables in the equation until a decision is reached on the equation to use (Draper and Smith, 1981).

c. The Stepwise Regression Procedure

It is an attempt to achieve a similar conclusion working from the other direction, that is, to insert variables in turn until the regression equation is satisfactory. The order of insertion is determined by using the partial correlation coefficient as a measure of the importance of variables not yet in the equation (Draper and Smith, 1981).

d. The t-Directed Search Method

This procedure discovered by Daniel and Wood (1981) has the following steps:

- Fit the full model.
- Identify the variables whose partial t-tests in the full model exceed in magnitude a predetermined threshold value.
- Let those variables with large t's be the "basic subset".
- Compute all possible regressions for the model that include the basic subset.

Assuming the coefficients associated to rainfall, acreage, quantity of seed available, quantity of millet-sorghum, time-trend, price of peanuts are respectively β_1, β_2, β_3, β_4, β_5, β_6, the expected signs will be as follows:

$$\beta_1 > 0,\ \beta_2 > 0,\ \beta_3 > 0,\ \beta_4 \gtrless 0,\ \beta_5 \gtrless 0,\ \beta_6 > 0$$

5.4.3 Regional Supplies

The same variables hypothesized for the national and official supply models are used at the regional level in estimating the regional supplies.

5.4.4 Domestic Demand

The three variables that appear to influence the total quantity of peanut oil demanded in Senegal are hypothesized to be domestic price of peanut oil, population and income. The expected coefficients associated with domestic price of peanut oil will be negative, and positive for both population and income.

CHAPTER 6

STATISTICAL ESTIMATION OF SUPPLY AND DEMAND AND EMPIRICAL RESULTS

As stated in Chapter 5, the Ordinary Least Squares procedure will be applied for both supply and demand models. Whenever the hypothesis of randomness of the errors is rejected, the Cochran Orcutt procedure will be used.

6.1 Functional Form

Two functional forms were considered for the regression equations, linear and natural double-logarithmic forms. In the linear regression form, each unit change in the exogenous variable (explanatory variable) changes the endogenous variable by the value of the coefficient, provided the other variables are held constant.

The coefficients obtained from the natural double-logarithmic form gives the percentage change in the dependent variable resulting from a percentage change in the associated explanatory variable, holding the other variables constant.

In the linear form, the elasticities are measured at the mean value of the relevant variables. Suppose

$$Y = aX + b.$$

Elasticity at mean value equals

$$\frac{\partial y}{\partial X} \cdot \frac{\bar{X}}{\bar{y}} = a \cdot \frac{\bar{X}}{\bar{y}}$$

The natural double-logarithmic form yields direct elasticity coefficients.

6.2 Empirical Findings

6.2.1 National Supply

In a first approach, nominal producer price of peanuts lagged one year was considered in addition to the other variables defined earlier. All the different variable combinations showed that only rainfall and acreage were statistically-significant variables affecting both the national production and the quantity marketed through official channels.

In a second approach, the expected nominal producer price was considered in addition to the other variables. Again, only rainfall and acreage appeared to be statistically significant in explaining the different supplies. Furthermore, any inclusion of one of the other variables not statistically significant tended to increase the mean square error of the model including rainfall and acreage. This then limits any chance of including them for prediction purposes.

A third approach patterned after Cheryl Christensen et. al's work (1980) was as follows:

Peanut supply = yield * acreage.

Unlike the authors above, both acreage and yield were assumed to be endogenous. The best model describing the yield function was as follows:

$$YIELD_t = \alpha_o + \beta_1 \frac{RPPR_t}{PFERT_t} + \beta_2 RF_t + \varepsilon_t$$

where

$YIELD_t$ = peanut yield in 1000 metric tons in year t,

$\frac{RPPR_t}{PFERT_t}$ = ratio of peanut price to fertilizer price in year t,

RF_t = amount of rainfall in millimeters in year t.

The peanut price used in the price ratio is the actual producer price in FCFA/KG in real terms in year t. It is the nominal support price announced prior to planting less the deductions made by the marketing board. The fertilizer price is the controlled price to producers in FCFA/KG in real terms in year t. Fertilizer price serves as proxy for the weighted unit cost of all variables inputs required by peanut producers to increase yields. The rainfall variable for year t is included to reflect the importance of weather factors in the production for Senegalese peanuts.

The estimated equations are shown in Table 6-1. From the linear function, the price ratio of peanuts to fertilizer is significant at 99 percent confidence level. Rainfall is significant at 100 percent confidence level. From the natural double logarithmic form, the ratio of peanut price to fertilizer price is significant at 98 percent confidence level, rainfall is significant at 100 percent confidence level.

Elasticities at mean values:

$$E_{\frac{RPPR}{PFERT}} = \frac{\partial YIELD}{\partial \frac{RPPR}{PFERT}} \cdot \frac{\frac{RPPR}{PFERT}}{YIELD} = 0.179 \frac{38.49}{16.84} = 0.409$$

$$E_{RF} = \frac{\partial\ YIELD.}{\partial\ RF} \cdot \frac{RF}{YIELD} = 0.000773 \frac{13360}{16.84} = 0.612$$

Assuming the elasticity coefficient of the ratio of peanut price to fertilizer price of 0.409 comes from peanut price holding fertilizer price constant at its mean, then a 10 percent increase in peanut price will bring forth 4.09 percent increase in peanut yield, all other variables being constant.

Table 6-1. OLS Estimated Equations for Peanut Yield in Senegal

Linear Model.

$$YIELD_t = -0.0207 + 0.179 \frac{RPPR_t}{PFERT_t} + 0.000773\ RF_t$$

Standard Error	(0.181)	(0.0667)	(0.000195)
t-statistics	(-0.115)	(2.692)	(3.971)

$R^2 = 0.5507$ $\quad \bar{R}^2 = 0.5008$

Durbin-Watson = 2.227 $\quad$ RMSE* = 0.132

Log-Log Model

$$\text{Log } YIELD_t = -5.223 + 0.392 \text{ Log } \frac{RPPR_t}{PFERT_t} + 0.738 \text{ Log } RF_t$$

Standard Error	(1.008)	(0.161)	(0.155)
t-statistics	(-5.18)	(2.427)	(4.746)

$R^2 = 0.6050$ $\quad \bar{R}^2 = 0.5611$

Durbin-Watson = 2.308 $\quad$ RMSE = 0.173

See page 56 for definition of variables

*RMSE = root mean square error = standard error of the regression.

The best model describing the acreage function was as follows:

$$ACR_t = \alpha_0 + \beta_1 TIME_t + \beta_2 RPPR_t + \beta_3 MS_{t-1} + \beta_4 ACR_{t-1} + \beta_5 RF_t + \varepsilon_t$$

where

ACR_t = total hectares under peanut cultivation in year t, in 1000,

$TIME_t$ = time index,

$RPPR_T$ = expected producer price (to be received by farmers when they market their crop) in real terms (FCFA/KG), in year t,

MS_{t-1} = quantity of millet sorghum produced in 1000 metric tons in year t-1,

ACR_{t-1} = total hectares under peanut cultivation in year t-1, in 1000,

RF_t = amount of rainfall in millimeters in year t.

There is economic logic for inclusion of each of these explanatory variables in the peanut acreage function. Inclusion of the time trend variable as independent variable means that the remaining variables serve to explain year-to-year deviation from the long-term trend in planted hectarage. The actual price of peanuts for year t is the expected price because it is announced before planting time. The quantity of millet and sorghum produced in year t-1 affects producers decisions on how much peanuts to plant in year t through its effect on carry-over inventories of these food grains. The total hectarage under peanut cultivation in year t-1 measures the total cultivated area the producer has to use in year t under the West African land tenure system. Rainfall in year t measures the producer's expected yield response (and therefore peanut profitability in year t) because he does not plant peanuts until after the season's rainfall starts.

The estimated equations are shown in Table 6-2. From the linear function, lagged millet-sorghum is significant at 96 percent confidence

Table 6-2. OLS Estimated Equations for Peanut Acreage in Senegal

Linear Model

$$ACR_t = 43.14 + 6.128\ TIME_t + 8.144\ RPPR_t + 0.328\ MS_{t-1} + 0.452\ ACR_{t-1} + 0.255\ RF_t$$

Standard Error	(376.483)	(5.121)	(8.718)	(0.143)
	(0.211)	(0.174)		
t-statistics	(0.115)	(1.199)	(0.934)	(2.291)
	(2.137)	(1.468)		

$R^2 = 0.4917$ $\bar{R}^2 = 0.3101$ RMSE = 74.566

Log-Log Model

$$\text{Log } ACR_t = 1.62 + 0.059 \text{ Log } TIME_t + 1.99 \text{ Log } RPPR_t + 0.145 \text{ Log } MS_{t-1} + 0.413 \text{ Log } ACR_{t-1} + 0.134 \text{ Log } RF_t$$

Standard Error	(1.835)	(0.041)	(0.159)	(0.067)	(0.209)	(0.086)
t-statistics	(0.883)	(1.452)	(1.255)	(2.145)	(1.971)	(1.547)

$R^2 = 0.4965$ $\bar{R}^2 = 0.3167$ RMSE = 0.065

See page 59 for definition of variables.

level. Lagged acreage is significant at 95 percent confidence level. The other variables, peanut price, rainfall and the time variable are not significant at 10 percent. From the natural double-logarithmic form, lagged millet-sorghum is significant at 95 percent confidence level, lagged acreage is significant at 93 percent confidence level. Rainfall, peanut price, and the time variable are not significant at 10 percent.

Elasticities at mean values:

$$E_{RPPR} = \frac{\partial ACR}{\partial RPPR} \cdot \frac{RPPR}{ACR} = 8.144 \frac{411.48}{22993} = 0.146$$

$$E_{MS_{t-1}} = \frac{\partial ACR}{\partial MS_{t-1}} \cdot \frac{MS_{t-1}}{ACR} = 0.328 \frac{10413}{22993} = 0.148$$

$$E_{RF} = \frac{\partial ACR}{\partial RF} \cdot \frac{RF}{ACR} = 0.255 \frac{13360}{22993} = 0.148$$

$$E_{ACR_{t-1}} = \frac{\partial ACR}{\partial ACR_{t-1}} \cdot \frac{ACR_{t-1}}{ACR} = 0.452 \frac{21927}{22993} = 0.431$$

A fourth alternative approach in attempting to model Senegalese peanut supply was to regress total peanut production onto the variables discussed in Chapter 5. The best model describing the behavior of the Senegalese peanut production is as follows:

$$PRO_t = \alpha_0 + \beta_1 RF_t + \beta_2 ACR_t + \beta_3 RPPR_t + \varepsilon_t$$

where

PRO_t = national peanut supply (production) in thousands of metric tons in year t,

RF_t = amount of rainfall in millimeters in year t,

ACR_t = number of hectares under peanut cultivation in year t (in thousands),

$RPPR_t$ = expected producer price (to be received by farmers when they market their crop) in real terms (FCFA/KG), in year t,

t = time index.

The estimated coefficients in linear and log forms are shown in Table 6.3. The linear equation reveals significant coefficients for acreage, rainfall and prices as expected. Acreage is the most significant variable. It is statistically significant at more than 99 percent confidence level. This reflects the importance of land extensive methods in traditional agriculture. Rainfall is significant at 97 percent confidence level. This is not surprising since in Sub-Saharan Africa, rainfall is an important factor in increasing agricultural production.

Producer price is significant at 98 percent confidence level. This then strengthens previous findings that African farmers appear to be price responsive (Bateman, 1965; Dean, 1965; Oni, 1969).

However, for both the linear and the natural double logarithmic forms examination of the Durbin-Watson statistics reveals some systematic patterns among the residuals suggesting some degree of autocorrelation in the error terms. Hence, the national supply function with rainfall, acreage and price as explanatory variables was reestimated using the Cochran-Orcutt procedure. The results are shown in Table 6-4. For the linear equation acreage is again significant at more than 99 percent confidence level. Rainfall is now significant at 95 percent confidence level. Producer price is significant at 99 percent confidence level. Furthermore, the root mean square error (RMSE) decreased from 145.691 to 140.275. The coefficient of determination (R^2) improved substantially from 0.6779 to 0.7586. For the natural double-logarithmic equation all the parameters are significant at 99 percent confidence level.

R^2 improved substantially from 0.6918 to 0.7749. Furthermore, the RMSE (root mean square error) decreased from 0.1697 to 0.160. Comparison of actual and estimated values of national peanut production

Table 6-3: OLS Estimated Equations for National Supply of Peanuts.

Linear Model:

$$PRO_t = -1986.86 + 0.57RF_t + 1.67ACR_t + 34.72RPPR_t$$

Standard error	(514.3)	(0.24)	(0.367)	(13.35)
t-statistics	(-3.863)	(2.330)	(4.541)	(2.601)

$R^2 = 0.6779$ $\bar{R}^2 = 0.6211$

Durbin-Watson = 2.615 RMSE = 145.691

Log-Log Model:

$$\text{Log } PRO_t = -11.985 + 0.5527 \text{ Log } RF_t + 1.8483 \text{ Log } ACR_t + 0.7579 \text{ Log } RPPR_t$$

Standard error	(3.7024)	(0.1717)	(0.481)	(0.3059)
t-statistics	(-3.237)	(3.219)	(3.847)	(2.477)

$R^2 = 0.6918$ $\bar{R}^2 = 0.6374$

Durbin-Watson = 2.665 RMSE = 0.1697

See page 61 for definition of variables.

Table 6-4. National Peanut Supply Functions Estimated by the Cochran-Orcutt procedure.

Linear Model

$$PRO_t = -2589.365 + 0.449\ RF_t + 1.707\ ACR_t + 35.3237\ RPPR_t$$

Standard error	(552.805)	(0.2172)	(0.3086)	(11.8433)
t-statistic	(-4.684)	(2.068)	(5.532)	(2.983)

$R^2 = 0.7586$ $\bar{R}^2 = 0.7133$

RMSE = 140.275

Log-Log Model

$$\text{Log } PRO_t = -16.215 + 0.4738 \text{ Log } RF_t + 1.9414 \text{ Log } ACR_t + 0.7268 \text{ Log } RPPR_t$$

Standard error	(4.05776)	(0.2473)	(0.3925)	(0.2547)
t-statistics	(-3.996)	(3.215)	(4.946)	(2.854)

$R^2 = 0.7749$ $\bar{R}^2 = 0.7327$

See page 61 for definition of variables.

SENEGALESE PEANUT PRODUCTION

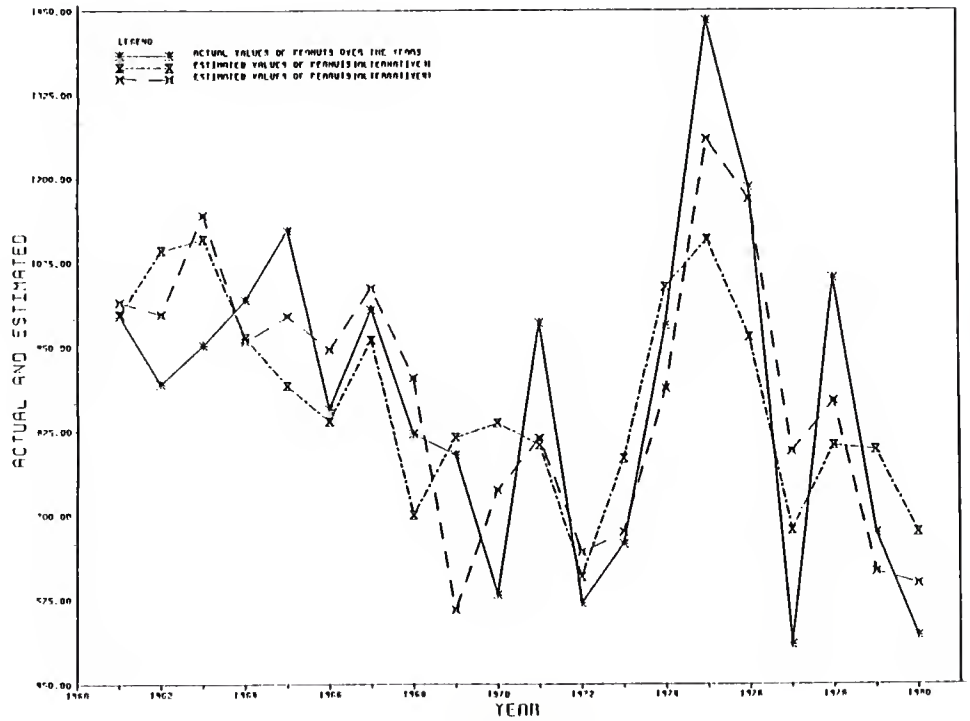

FIGURE 1

based on approaches 3 and 4 is shown in Figure 1. The estimates are based on the linear models in Tables 6-1, 6-2, 6-3.

6.2.2 Official Supply (Sales)

The best model for the official supply is as follows:

$$QS_t = \alpha_0 + \beta_1 RF_t + \beta_2 ACR_t + \beta_3 RPPR_t + \varepsilon_t$$

where

QS_t = total peanut traded by farmers through the ONCAD marketing board in thousands of metric tons in year t.

The other variables are defined same as earlier.

The estimated equations are shown in Table 6-5. In the linear equation, acreage is significant at more than 99 percent confidence level. Real producer price is significant at 99 percent confidence level, whereas rainfall is significant at 92 percent confidence level.

For both the national and official supplies, the overall conclusions that can be drawn are that:

a. Senegalese peanut supply response does not depend on the lagged nominal producer price; nor does it depend on the expected nominal producer price.

b. Rather, the farmers base their decision upon the expected real producer price they will receive when they market their crop.

Indeed this determines their purchasing power. Thus, farmers appear to be economically rational. Findings with respect to the expected peanut price are consistent with our knowledge of the Senegalese peanut economy because the government announces the producer prices of agricultural commodities well in advance before the farmers plant their crops. This idea is confirmed by a USAID paper (MAI 1983), Gaye and Andersen (1983) and Sow, P.A. (1983).

Table 6-5. OLS Estimated Equations for Official Supply (Sales) of Peanuts in Senegal.

Linear Model

$QS_t = -2279.357 + 0.4931\ RF_t + 1.6692\ ACR_t + 45.3142\ RPPR_t$

Standard error	(564.552)	(0.2669)	(0.4033)	(14.6576)
t-statistics	(-4.037)	(1.847)	(4.139)	(3.092)

$R^2 = 0.66$ $\bar{R}^2 = 0.60$

Durbin-Watson = 2.279 RMSE = 159.928

Log-Log Model

$\text{Log } QS_t = -18.2174 + 0.6748 \text{ Log } RF_t + 2.341 \text{ Log } ACR_t + 1.367 \text{ Log } RPPR_t$

Standard error	(6.1316)	(0.2844)	(0.7967)	(0.5067)
t-statistics	(-2.971)	(2.373)	(2.938)	(2.698)

$R^2 = 0.6180$ $\bar{R}^2 = 0.5505$

Durbin-Watson = 1.646

See page 66 for definition of variables.

The plot of actual and estimated peanut sales to the marketing board in Senegal is shown in Figure 2. The estimates are based on the linear model in Table 6-5.

6.2.3 Regional Supplies

The purpose in this section of the study is to estimate regional supply models based on reported sales to the marketing board. In Senegal, there are eight administrative regions. However, for the purpose of the regional sales, only five regions are considered. These are: Sine-Saloum, Thies, Diourbel-Louga, called the peanut belt, plus Casamance and Senegal Oriental. The rationale behind combining Diourbel and Louga is only methodological. In fact, Louga became an administrative region just recently and before it was included in Diourbel.

6.2.3.1 Sine-Saloum. The best model for this region is the one including acreage and real producer price as below.

$$QS_t = \alpha_0 + \beta_1 ACR_t + \beta_t RPPR_t + \varepsilon_t$$

where

QS_t = quantity of peanuts officially traded in the region in thousands of metric tons in year t,

ACR_t = total hectares under peanut cultivation (in the region) in year t (in 1000),

$RPPR_t$ = price received in year t in F CFA/KG.

The estimated equations are shown in Table 6-6. In the linear equation, acreage is significant at more than 99 percent confidence level. Producer price is significant at 98 percent confidence level.

Comparison of the reported and estimated sales to the marketing board in Sine-Saloum based on the linear model in Table 6-6 are shown in Figure 3.

TOTAL PEANUT SALES TO THE MARKETING BOARD

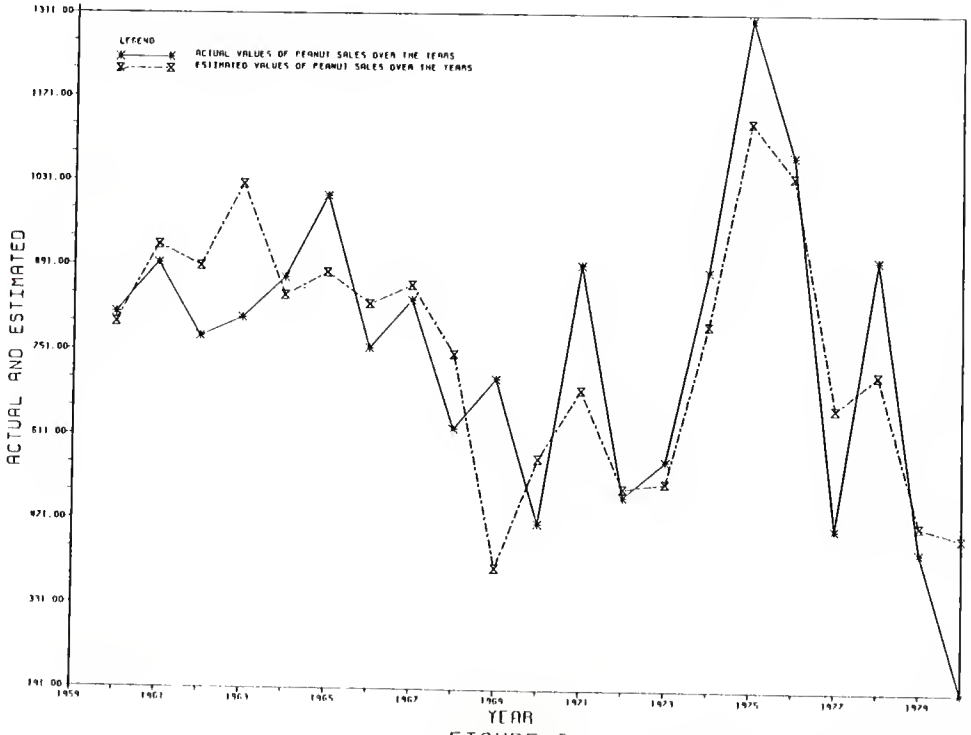

FIGURE 2

Table 6-6. OLS Estimated Equations for Regional Peanut Sales in Sine Saloum.

Linear Model

$QS_t = -453.802 + 1.016\ ACR_t + 16.72\ RPPR_t$

Standard error	(200.554)	(0.3391)	(6.9257)
t-statistics	(-2.263)	(2.998)	(2.414)

$R^2 = 0.5097$ $\bar{R}^2 = 0.4484$

Durbin-Watson = 2.074 MSE = 5729.18

Log-Log Model

$\text{Log } QS_t = -5.3495 + 1.32 \text{ Log } ACR_t + 1.027 \text{ Log } RPPR_t$

Standard error	(2.9799)	(0.4602)	(0.3658)
t-statistics	(-1.795)	(2.871)	(2.808)

$R^2 = 0.5017$ $\bar{R}^2 = 0.443$

Durbin-Watson = 2.276 MSE = 0.04944

See page 68 for definition of variables.

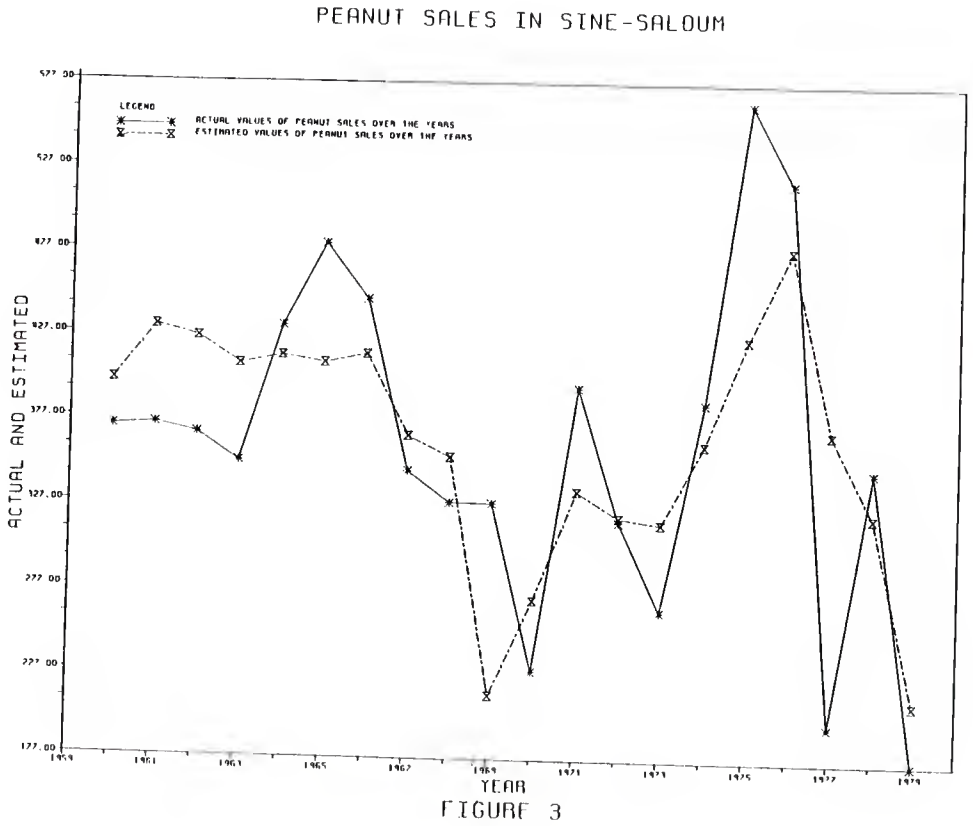
PEANUT SALES IN SINE-SALOUM
LEGEND
ACTUAL VALUES OF PEANUT SALES OVER THE YEARS
ESTIMATED VALUES OF PEANUT SALES OVER THE YEARS
ACTUAL AND ESTIMATED
YEAR

FIGURE 3

6.2.3.2 Diourbel-Louga. The best model selected includes rainfall, seed and producer price.

$$QS_t = \alpha_0 + \beta_1 RF_t + \beta_2 SEED_t + \beta_3 RPPR_t + \varepsilon_t$$

QS_t = quantity of peanuts officially traded in thousands of metric tons in year t,

RF_t = amount of rainfall in the region in millimeters (in year t),

$RPPR_t$ = producer price received by farmers in F CFA/KC (in year t),

$SEED_t$ = total quantity of seed used in the region in 1000 metric tons (in year t),

ε_t = error term.

The estimated equations are shown in Table 6-7. Examining the linear equation reveals that rainfall is significant at 99 percent confidence level. Seed availability is significant at more than 99 percent confidence level. Producer price is significant at 96 percent confidence level.

Comparison of the reported and estimated sales to the marketing board in Diourbel-Louga based on the linear model in Table 6-7 are shown in Figure 4.

6.2.3.3 Thies. The best model describing the sales of peanuts in the region is as follows:

$$QS_t = \alpha_0 + \beta_1 ACR_t + \beta_2 MS_{t-1} + \beta_3 RPPR_t + \varepsilon_t$$

where

QS_t = quantity of peanuts officially traded in the region in thousands of metric tons in year t,

ACR_t = total hectares under peanut cultivation in year t (in 1000),

Table 6-7. OLS Estimated Equations for Regional Peanut Sales in Diourbel-Louga.

Linear Model

$$QS_t = -479.34 + 0.3709\ RF_t + 7.7731\ SEED_t + 14.123\ RPPR_t$$

Standard Error	(183.774)	(0.138207)	(2.4207)	(6.43026)
t-statistics	(-2.608)	(2.684)	(3.224)	(2.196)

$R^2 = 0.4815$ $\bar{R}^2 = 0.3843$

Durbin-Watson = 1.803 MSE = 3973.44

Log-Log Model

$$\text{Log } QS_t = -12.051 + 1.307 \text{ Log } RF_t + 1.3036 \text{ Log SEED} + 1.6594 \text{ Log } RPPR_t$$

Standard Error	(4.2226)	(0.393)	(0.431)	(0.8011)
t-statistics	(-2.854)	(3.326)	(3.024)	(2.071)

$R^2 = 0.5282$ $\bar{R}^2 = 0.4397$

Durbin-Watson = 1.896 MSE = 0.144586

See page 72 for definition of variables.

PEANUT SALES IN DIOURBEL-LOUGA

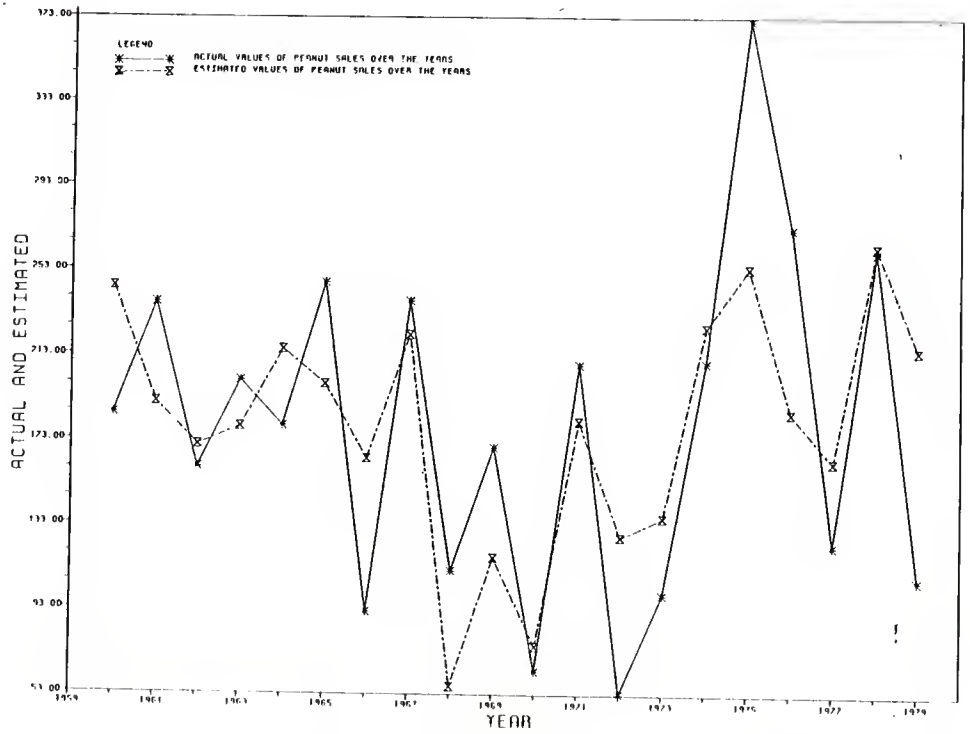

FIGURE 4

MS_{t-1} = quantity of millet-sorghum produced lagged one year (in 1000 metric tons),

$RPPR_t$ = producer price received by farmers in F CFA/KG, in year t.

The estimated equations are shown in Table 6-8. The linear equation reveals that producer price is the most significant variable. It is significant at 99 percent confidence level. Lagged millet-sorghum is significant at 93 percent confidence level. The coefficient associated with lagged millet-sorghum is negative which suggests that in absolute terms a one percent increase in the quantity of millet-sorghum produced last year will be associated with a decrease in peanut sales of 0.7026 the following year. This could be explained by the importance of hectarage substitution between peanuts and millet-sorghum in Thies region.

Comparison of the reported and estimated sales to the marketing board in Thies based on the linear model in Table 6-8 are shown in Figure 5.

6.2.3.4 Casamance. The best model selected for this region is as follows:

$$QS_t = \alpha_0 + \beta_1 RF_t + \beta_2 SEED_t + \beta_3 RPPR_t + \varepsilon_t$$

where

QS_t = quantity of peanuts officially traded in thousands of metric tons in year t,

RF_t = amount of rainfall in millimeters in year t,

$SEED_t$ = total quantity of seed used in the region in 1000 metric tons, in year t,

$RPPR_t$ = producer price in F CFA/KG in year t,

ε_t = error term.

Table 6-8. OLS Estimated Equations for Regional Peanut Sales in Thies.

Linear Model

$$QS_t = -212.415 + 1.2483\ ACR_t - 0.7026\ MS_{t-1} + 8.7748\ RPPR_t$$

Standard Error	(104.327)	(0.51176)	(0.3594)	(3.3597)
t-statistics	(-2.036)	(2.439)	(-1.955)	(2.612)

$R^2 = 0.4217$ $\bar{R}^2 = 0.3061$

Durbin-Watson = 2.182 MSE = 1277.725

Log-Log Model

$$\text{Log } QS_t = -6.2853 + 1.2591 \text{ Log } ACR_t - 0.4199 \text{ Log } MS_{t-1} + 2.077 \text{ Log } RPPR_t$$

Standard Error	(6.8769)	(1.1657)	(0.2942)	(1.088)
t-statistics	(-0.914)	(1.080)	(-1.427)	(1.909)

$R^2 = 0.2481$ $\bar{R}^2 = 0.0978$

Durbin-Watson = 1.891 MSE = 0.3425

See page 72 for definition of variables.

PEANUT SALES IN THIES

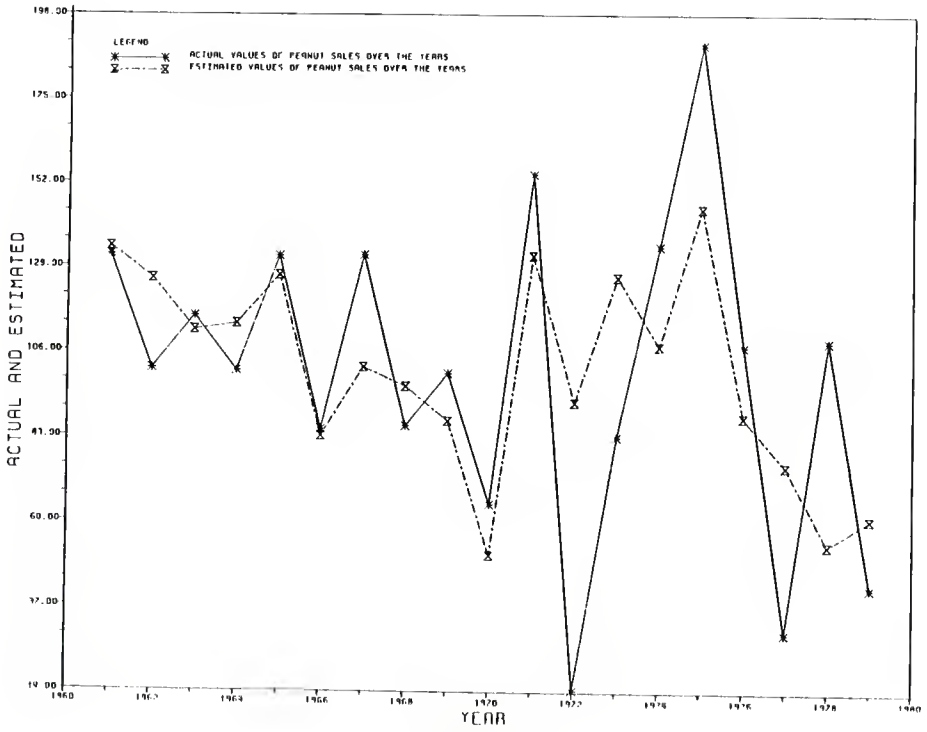

FIGURE 5

The estimated equations are shown in Table 6-9. From the linear model, it appears that producer price is the most significant variable. It is statistically significant at more than 99 percent confidence level. Seed is significant at 99 percent confidence level. Rainfall is significant at 95 percent confidence level.

Comparison of the reported and estimated sales to the marketing board in the Casamance based on the linear model in Table 6-9 are shown in Figure 6.

6.2.3.5 Senegal Oriental. The best model selected is as follows:

$$QS_t = \alpha_0 + \beta_1 ACR_t + \beta_2 RPPR_t + \varepsilon_t$$

where

QS_t = quantity of peanuts officially traded in Senegal Oriental in thousands of metric tons in year t,

ACR_t = total hectares under peanut cultivation (in thousands) in year t,

$RPPR_t$ = producer price in F CFA/KG.

The estimated equations are shown in Table 6-10. It appears that acreage is significant at more than 99 percent confidence level. Producer price is significant at 99 percent confidence level.

Comparison of the reported and estimated sales to the marketing board in Senegal Oriental based on the linear model in Table 6-8 are shown in Figure 7.

6.2.4 Stability of the National Supply

In order to investigate the stability of the national supply model, the Chow test was used. It is used to test for equality of two regressions as an indication of whether or not using the entire time

Table 6-9. OLS Estimated Equations for Regional Peanut Sales in the Casamance.

Linear Model

$QS_t = -45.56 + 0.028\ RF_t + 2.72\ SEED_t + 4.15\ RPPR_t$

Standard Error	(34.039)	(0.0138)	(0.999)	(1.150)
t-statistics	(-1.339)	(2.070)	(2.722)	(3.612)

$R^2 = 0.5375$ $\bar{R}^2 = 0.4507$

Durbin-Watson = 2.346 MSE* = 144.805

Log-Log Model

$\text{Log } QS_t = -0.9955 + 0.299 \text{ Log } RF_t + 0.2685 \text{ Log } SEED_t + 0.9569 \text{ Log } RPPR_t$

Standard Error	(1.5393)	(0.1689)	(0.1167)	(012699)
t-statistics	(-0.647)	(1.770)	(2.300)	(3.544)

$R^2 = 0.5140$ $\bar{R}^2 = 0.4228$

Durbin-Watson = 2.216 MSE* = 0.01868

MSE* = Mean Square Error

See page 75 for definition of variables.

PEANUT SALES IN CASAMANCE

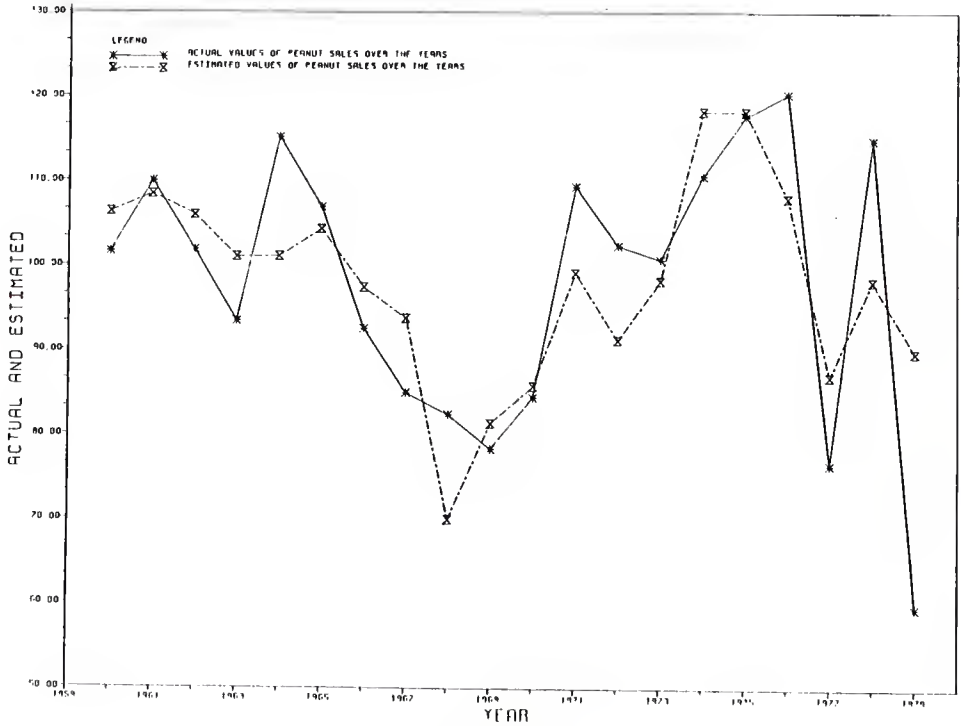

FIGURE 6

6-10. OLS Estimated Equations for Regional Peanut Sales in Senegal Oriental.

Linear Model

$QS_t = -46.63 + 0.9735\ ACR_t + 2.000\ RPPR_t$

Standard Error	(19.807)	(0.20509)	(0.7583)
t-statistics	(-2.354)	(4.747)	(2.639)

$R^2 = 0.598$ $\bar{R}^2 = 0.5477$

Durbin-Watson = 1.706 MSE = 71.37

Log-Log Model

$\text{Log } QS_t = -5.047 + 1.159 \text{ Log } ACR_t + 1.41 \text{ Log } RPPR_t$

Standard Error	(1.902)	(0.2719)	(0.4524)
t-statistics	(-2.654)	(4.264)	(3.119)

$R^2 = 0.5805$ $\bar{R}^2 = 0.5280$

Durbin-Watson = 1.647 MSE = 0.06527

See page 78 for definition of variables.

PEANUT SALES IN SENEGAL-ORIENTAL

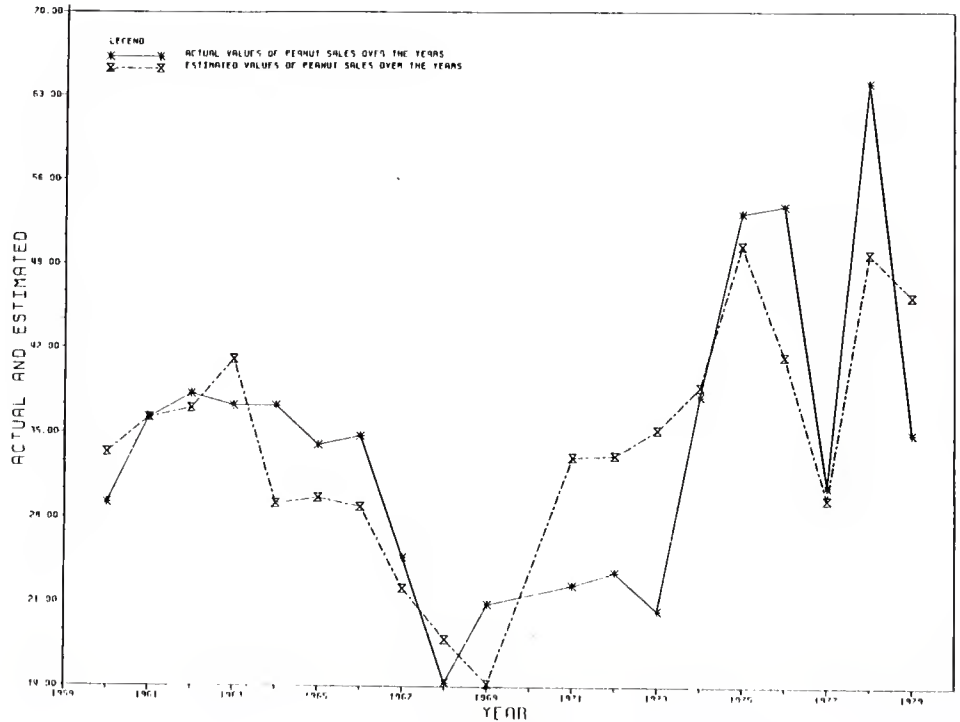

FIGURE 7

series data (1960 to 1980) is appropriate. For the purpose of this study the entire time series was split into two time series with T_1 and T_2 observations.

T_1 contains 10 observations.

T_2 contains 11 observations.

A separate regression was run for each set of observations. If the null hypothesis

$$Ho = \beta_1 = \beta_2 = \beta$$

is true, the entire time series data, i.e., $T = T_1 + T_2$ could be used to estimate a single equation.

$$F_c = \frac{SSE - (SSE_1 + SSE_2)/K}{(SSE_1 + SSE_2)/T - 2K}$$

$$F_c = \frac{360839 - (59556.276 + 146963)/4}{(59556.276 + 146963)/13}$$

$$F_c = 2.428 \qquad F_{.05}(4,13) = 3.18$$

Since $F_c = 2.428 < 3.18$ we fail to reject H_o.

Thus, the national supply is stable for the entire time series and the data can be used to estimate a single equation.

6.2.5 Peanut Oil Demand

As stated in Chapter 5, the peanut oil demand model is hypothesized to be influenced by domestic price, population and income as follows:

$$QD_t = \alpha_0 + \beta_1 DOMPRI_t + \beta_2 INCOME_t + \beta_3 POP_t + \varepsilon_t$$

where

QD_t = quantity of peanut oil demanded (consumed) in metric tons in year t,

$DOMPRI_t$ = domestic price of peanut oil in F CFA per metric ton in year t (deflated),

$INCOME_t$ = total income of Senegal in thousands of F CFA in year t (deflated),

POP_t = population of Senegal in thousands in year t,

ε_t = error term.

α_0, β_1, β_2 and β_3 are the parameters to be estimated.

The Ordinary Least Squares procedure suggests there is multicollinearity between income and population. Theoretically this is to be expected. According to Tomek and Robinson (1981), population and income often follow the same pattern through time. Thus, including such variables separately in an equation may make it difficult to disentangle statistically the separate effects of the variables. Therefore, population was removed and the equation reestimated.

Furthermore, existence of high leverage points was detected in the time series. This appeared from the COOK's D statistics. Therefore, the 18th and 20th observations corresponding to 1978 and 1980 were deleted. The results obtained from the OLS are shown in Table 6-11.

Income is highly significant. It is statistically significant at more than 99 percent confidence level. Domestic price is significant at 97 percent confidence level. In addition, both income and domestic price have the expected signs.

Elasticities at mean values are:

$$E_{DOMPRI} = \frac{\partial QD}{\partial DOMPRI} \cdot \frac{DOMPRI}{QD} = -0.1991 \frac{1789367}{742850} = -0.479$$

$$E_{INCOME} = \frac{\partial QD}{\partial INCOME} \cdot \frac{INCOME}{QD} = 0.05278 \frac{4830600}{742850} = 0.3432$$

Table 6-11. OLS Estimated Equations for Domestic Peanut Oil Demand in Senegal.

QD = 44437.7 - 0.199 DOMPRI + 0.05278 INCOME

Standard Error	(8837.416)	(0.0854)	(0.00877)
t-statistics	(5.028)	(-2.333)	(6.018)

R^2 = 0.7555 $\bar{R}^2$ = 0.725

Durbin-Watson = 1.942 RMSE = 4628

See page 84 for definition of variables.

It appears from the elasticity estimates that peanut oil demand is price inelastic. Thus, total income to producers of peanut oil decreases with increase in supply. This could be one explanation for the financial difficulties the oil mills have under recent conditions. Furthermore, the income elasticity of demand for peanut oil is inelastic. This should be expected because in the Senegalese dietary system peanut oil is a basic food as such it should have low positive income elasticity.

The plot of actual and estimated peanut oil consumption in Senegal is shown in Figure 8. The estimates are based on the linear model in Table 6-11.

The overall implication of this analysis is that because the demand for peanut oil by consumers is price inelastic, the sales of peanut oil to the consumers at substantially subsidized prices will not in itself induce proportionate expansion of the industry.

PEANUT OIL DEMAND IN SENEGAL

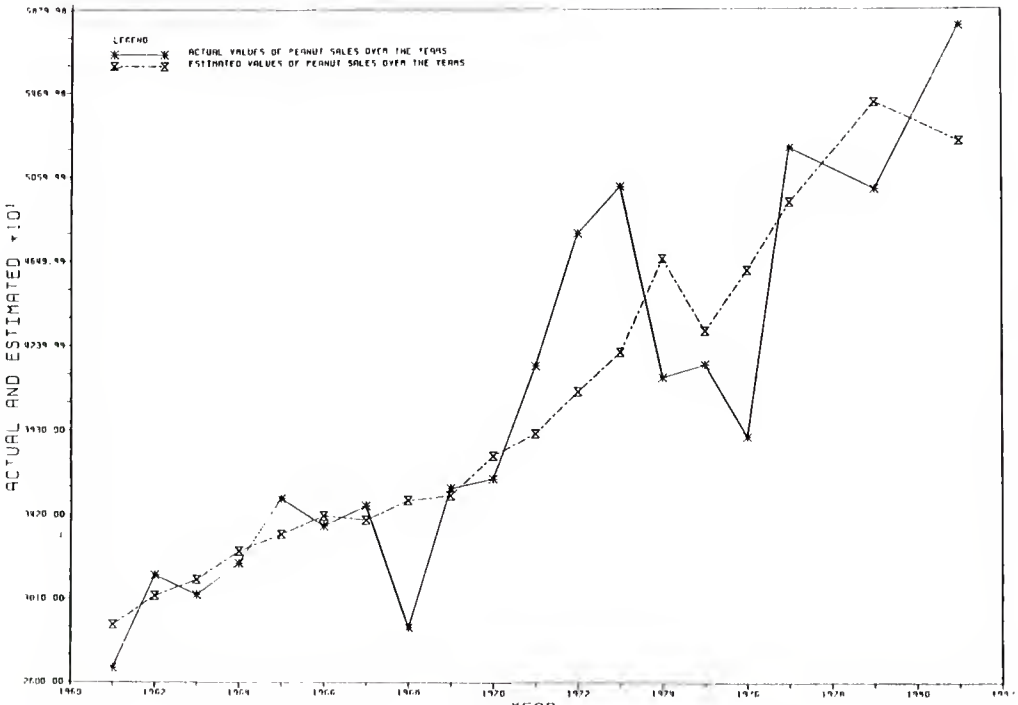

FIGURE 8

CHAPTER 7

PROJECTIONS OF DEMAND FOR SENEGALESE PEANUT OIL

7.1 Projections of Domestic Peanut Oil Demand

This projection follows the FAO-OECD method. This method is based on rate of growth in per capita income, income elasticity of demand and rate of growth of population as follows:

$$(1) \quad d = pop + \delta y$$

$$(2) \quad D_t = D_o(1 + d)^T$$

where

d = annual rate of growth of consumption,

pop = annual rate of growth of population,

δ = income elasticity of demand,

y = annual rate of growth of per capita income,

D_o = total national consumption at time $t = 0$,

T = time in years from D_o to D_t.

The different values for the rate of growth of population and per capita income are obtained from FAO, Agricultural Commodities Projections for 1975 and 1985.

The income elasticity of demand is that obtained in the peanut oil demand model. Because of the fact that the demand for peanut oil did not exhibit any particular pattern, the average consumption for the period 1975-1981 is used for D_o.

Alternative projections of domestic peanut oil consumption for 1982-1990 at annual population growth rates of 2.1 and 2.4 percent, and growth rates in annual average per capita income of 0.5, 0.8, 2.1, and 2.4 percent are shown in Table 7-1.

Table 7-1. Projections of Peanut Oil Consumption in Senegal at Alternative Growth Rates for Population and Per Capita Income.
(unit = metric tons)

		Annual Growth Rate in Average Per Capita Income			
	Year	(1) 0.5 Percent	(2) 0.8 Percent	(3) 2.1 Percent	(4) 2.4 Percent
A. Population Growth Rate = 2.1%	1982	48,965.0	49,012.8	49,224.5	49,273.3
	1983	50,074.8	50,175.3	50,606.2	50,711.5
	1984	51,209.4	51,362.7	52,028.1	52,186.1
	1985	52,372.9	52,578.7	53,493.2	53,718.2
	1986	53,560.2	53,823.5	54,996.5	55,283.8
	1987	54,776.3	55,101.9	56,543.0	56,897.3
	1988	56,016.3	56,408.9	58,122.9	58,553.8
	1989	57,285.1	57,744.7	59,760.3	60,263.0
	1990	58,587.3	59,114.0	61,440.8	62,020.1
B. Population Growth Rate = 2.4%	1982	49,107.6	49,156.5	49,368.1	49,416.9
	1983	50,366.8	50,469.7	50,903.0	51,003.6
	1984	51,695.5	51,817.5	52,487.8	52,645.8
	1985	53,000.0	53,191.6	54,120.4	54,335.8
	1986	54,340.6	54,627.9	55,805.7	56,083.3
	1987	55,738.6	56,064.2	57,543.6	57,883.5
	1988	57,165.4	57,548.4	59,334.2	59,745.9
	1989	58,649.6	59,080.5	61,182.3	61,665.8
	1990	60,133.8	60,655.6	63,087.8	63,647.9

Examination of the projections leads to the following observations. Domestic peanut oil consumption steadily increases from 1982 to 1990 due to rising population and income levels. At 2.1 percent population growth and 0.5 percent growth rate of per capita income, peanut oil consumption will rise from the 1982 level by about 7 percent in 1985 and by 20 percent in 1990. At 2.1 percent population growth and 0.8 percent growth rate of income per capita, consumption will increase by 7.3 percent in 1985 and by 20.6 percent in 1990. At 2.1 percent population growth and 2.1 percent growth rate of income per capita, consumption will rise by 8.7 percent in 1985 and by 24.8 percent in 1990. At 2.1 percent population growth and 2.4 percent growth rate of income per capita, consumption will rise by 9 percent in 1985 and by 25.9 percent in 1990. At 2.4 percent population growth and 0.5 percent growth rate of income per capita, consumption will increase by 7.9 percent in 1985 and by 22.4 percent in 1990. At 2.4 percent population growth and 0.8 percent growth rate of income per capita, consumption will increase by 8.2 percent in 1985 and by 23.4 percent in 1990. At 2.4 percent population growth and 2.1 percent growth rate of income per capita, consumption will rise by 9.6 percent in 1985 and by 27.8 percent in 1990. At 2.4 percent population growth and 2.4 percent growth rate of income per capita, consumption will rise by 10 percent in 1985 and by 28.8 percent in 1990.

Based on the projections, the challenge in the years to come will be for the government to stimulate high growth rate of income per capita. This aim needs to be accomplished not only from the industrial sector, but also from the agricultural sector by increasing the level of welfare of people in rural areas.

Another component lies in the provision of sustained increase in peanut production to meet the additional demand for peanut oil for the years ahead. Otherwise, the government will face the situation of importing other oilseeds and vegetable oils to meet the increasing local consumption requirements. If this happens it is likely that the foreign exchange earnings of the country will be greatly affected.

7.2 Projection of Peanut Oil Exports

This section reports investigation of trends and projection of Senegalese peanut oil exports in European countries, namely France, Italy and the EEC as a whole. The steps involved in the projections can be described as follows:

(a) GDP per capita indices for country X for 1975 and 1985 are α and β respectively.

(b) The quantity of Senegalese peanut oil imported by country X in 1980 equals y metric tons.

(c) Income elasticity of demand for vegetable oil equals Σ.

To estimate the level of demand for Senegalese peanut oil in France in 1985, the following projection equation is applied:

$$Q_{1985} = Q_o + Q_o \Sigma N$$

where

Q_{1985} = projected quantity of Senegalese peanut oil imported by France in 1985,

Q_o = quantity of Senegalese peanut oil imported by France in 1980,

Σ = income elasticity of demand for vegetable oil (France),

N = percent change in GDP per capita in France.

Substituting the appropriate figures for the parameters

$$Q_{1985} = 65300 + 65300\ (0.1 \times \frac{24.1}{131.0})$$

$$Q_{1985} = 66501 \text{ metric tons.}$$

The same procedure applied for Italy and the EEC gives the following:

Italy

$$Q_{1985} = 2860 \text{ metric tons}$$

EEC

$$Q_{1985} = 95961 \text{ metric tons.}$$

Based on these projections the aggregate foreign demand for the Senegalese peanut oil will continue to increase. Compared with 1980, the percentage increase for 1985 will be 1.8, 5.9 and 3.2 for France, Italy and the EEC respectively. This means that larger increase in Senegalese peanut oil exports will be expected in areas which hitherto have demanded a very small proportion of the Senegalese peanut oil such as Italy. Given the limitations of the projections based on constant factor price assumptions, which may not be realistic in light of the present situation in the world market, the Senegalese government through SONACOS and SEIB which market peanut oil should think of ways to pursue aggressive sales promotion in the EEC countries, namely France, in order to capture the ground that is being lost. In addition, based on the percentage increases in future Senegalese peanut oil exports to Italy, the government should explore ways to implement bilateral trade agreements based on EEC regulations. Furthermore, an effort to increase peanut oil sales in African countries is highly recommended.

TABLE 7-2 Projected Per Capita GDP, Income Elasticity of Demand and Senegalese Peanul Oil Imports for France, Italy and EEC Total.

Country	Per capita GDP 1975 index	Per capita GDP 1985 index	Income elasticity of demand for vegetable oil	Senegalese imports in 1980 metric tons
France	131.0	155.1	0.1	65300
Italy	132.4	158.6	0.3	2700
EEC Total	131.9	156.6	0.17	93000

Note: Per capita GDP indices and income elasticities of demand were obtained from FAO, Agricultural Commodities Projections for 1975 and 1985, Volume II. Senegalese imports were obtained from Gaye and Andersen Tome 3. Filiere Arachide-Huile. For the per capita GDP indices we considered the low figure for 1975 and the high figure for 1985.

CHAPTER 8

MODEL INCLUDING INTERNATIONAL TRADE

8.1 Peanut Exports Model

The quantity of peanuts that can be exported by Senegal in a given year depends upon the quantity of peanuts traded through official channels which depends on current production. Other relevant variables are peanut prices, both domestic and for export. An increase in the domestic price of peanuts is likely to increase the quantity of peanuts allocated for exports. In fact, an increase in the domestic peanut price means that farmers increase their sales to the marketing board and this will increase the quantity of peanut available for exports, everything held constant. Furthermore, an increase in export prices should normally induce greater export sales. However, in certain cases the reverse happens, such as when speculation comes to play.

In a first approach, Senegalese peanut export model has been hypothesized as follows:

$$PEXP_t = \alpha_0 + \beta_1 QS_t + \beta_2 DOMPRI_t + \beta_3 EXPRICE_t + \beta_4 TIME_t + \varepsilon_t$$

where

$PEXP_t$ = Quantity of peanuts exported (unshelled) in metric tons in year t,

QS_t = Quantity of peanuts traded by farmers through official channels in metric tons in year t,

$DOMPRI_t$ = Domestic price of peanuts in CFA francs per metric ton in year t (deflated),

$EXPRICE_t$ = World peanut price (FOB Rotterdam) in CFA francs per metric ton in year t (deflated),

$TIME_t$ = Time variable 1960 = 1,

t = Time index,

ε_t = Error term.

α_0, β_1, β_2, β_3, β_4 are the parameters to be estimated. The regression results are summarized in Table 8-1.

It appears that when quantity of peanuts traded, domestic price, world price and time are all included in the model, only world price and time are statistically significant in explaining Senegalese peanut exports.

The variables that are not statistically significant were removed and the equation reestimated; the Durbin-Watson statistics now show that the errors are more random than previously. Furthermore, the model performs better in terms of mean square error. The sign of the β-value associated with world price is inconsistent with economic theory, however. The results indicate that in absolute terms, an increase in the current export price will reduce the quantity of peanuts exported. This does not seem to be economically realistic. Export price is significant at more than 99 percent confidence level. Time is significant at 100 percent confidence level.

In a second approach, lagged peanut export price and the ratio of lagged export price to the domestic peanut price were considered in addition to quantity supplied through official channels and the time variable as variables affecting peanut exports. The purpose of this approach was to test two hypotheses:

1. Response in export sales by the marketing board lags export price changes (because of price speculation, for example).

2. Under the conditions of (1), the ratio of lagged peanut export price to domestic peanut price does not matter to the marketing board. The model specified was as follows:

Table 8-1 OLS Estimated Equations for Senegalese Peanut Exports.

$$PEXP_t = 1068730 - 0.002658\ QS_t - 8.57\ DOMPRI_t - 2.299\ EXPRICE_t - 38133.52\ TIME_t$$

Standard Error	(221725)	(0.066385)	(7.87)	(0.571)	(5081.958)
t-statistics	(4.820)	(-0.040)	(-1.089)	(-4.027)	(-7.504)

$R^2 = 0.8634$ $\bar{R}^2 = 0.8293$

Durbin-Watson = 2.422 ; RMSE = 64746.594

$$PEXP_t = 839765 - 2.154\ EXPRICE_t - 34507.9\ TIME_t$$

Standard Error	(112060)	(0.5475)	(4032.256)
t-statistics	(7.494)	(-3.934)	(-8.558)

$R^2 = 0.851$ $\bar{R}^2 = 0.8345$

Durbin-Watson = 1.999 RMSE = 63752.772

See page 94 for definition of variables.

$$PEXP_t = \alpha_0 + \beta_1 QS_t + \beta_2 DOMPRI_t + \beta_3 EXPRICE_{t-1} + \beta_4 \frac{EXPRICE_{t-1}}{DOMPRI_t} + \beta_5 TIME_t + \varepsilon_t.$$

where $PEXP_t$, QS_t, $DOMPRI_t$, $TIME_t$ are defined as above.

$EXPRICE_{t-1}$ = World peanut price (FOB Rotterdam) in CFA francs per metric ton in year t-1 (deflated).

The regression results are shown in Table 8-2. Time is highly significant. It is statistically significant at 100 percent confidence level. The other variables are not significant, which may suggest that the time variable is acting as proxy for other factors nc included in the model. Furthermore, the signs of the coefficients associated with the variable other than time appear to contradict economic theory.

The time variable was dropped and the equation reestimated. The regression results are summarized in the lower portion of Table 8-2. The coefficient of determination (R^2) drops from 0.8763 to 0.3262, indicating that the time variable alone explains 0.55 of the observed variation in export sales. Even though none of the other variables is statistically significant, the signs of the associated coefficients start to turn in the right direction.

In a third approach, the average of the current and lagged peanut export price was considered. The purpose was to simulate a shorter period of adjustment to prices for the marketing board since quarterly data was not used for the study. The model fitted was expressed as follows:

$$PEXP_t = \alpha_0 + \beta_1 QS_t + \beta_2 DOMPRI_t + \beta_3 \frac{EXPRICE_t + EXPRICE_{t-1}}{2} + \beta_4 TIME_t + \varepsilon_t$$

Table 8-2. OLS Estimated Equations for Senegalese Peanut Exports (continued).

$$PEXP_t = 368711 + 0.010\ QS_t + 30.25\ DOMPRI_t - 6.53\ EXPRICE_{t-1} + 71043.8\ \frac{EXPRICE_{t-1}}{DOMPRI_t} - 34980.91\ TIME_t$$

Standard Error	(919389)	(0.0792)	(52.212)	(6.833)
	(121470)	(4434.36)		
t-statistics	(0.401)	(0.131)	(0.579)	(-0.956)
	(0.585)	(-7.889)		

$R^2 = 0.8763$ $\bar{R}^2 = 0.8321$

Durbin-Watson = 2.32; RMSE = 63442.4

$$PEXP_t = -2166614 - 0.093\ QS_t + 128.6\ DOMPRI_t - 13.33\ EXPRICE_{t-1} + 247421\ \frac{EXPRICE_{t-1}}{DOMPRI_t}$$

Standard Error	(1941845)	(0.176045)	(114.301)	
	(15.283)	(269154)		
t-statistics	(-1.116)	(-0.533)	(1.125)	
	(-0.872)	(0.919)		

$R^2 = 0.3262$ $\bar{R}^2 = 0.1466$

Durbin-Watson = 0.513; RMSE = 143020

See page 97 for definition of variables.

where $PEXP_t$, $DOMPRI_t$, $EXPRICE_{t-1}$, $TIME_t$ are defined as before.

The results of the analysis are summarized in Table 8-3. Again, the time variable is significant at 100 percent confidence level. The average of the current and past price is significant at 100 percent confidence level, but the sign of the coefficient associated is negative. The other variables, quantity of peanuts supplied through official channels and domestic peanut price are not statistically significant.

The time variable was dropped and the equation reestimated. The results are summarized in the lower section of Table 8-3. The coefficient of determination dropped from 0.8760 to 0.3122. The price variables are not significant, but the coefficients are of expected signs.

The overall conclusion that can be drawn from the analysis is that the world peanut market is more complex than reflected by any of the models tried. The inclusion of time as proxy for the relevant variables not included in the different models attempted results in statistically significant R^2 values. However, the time value dominates the estimated equations and affects the direction of the signs of the other independent variables. Future research is needed to develop useful estimated equations of export supply response for Senegalese peanuts.

8.2 Peanut Oil Export Model

The alternative approaches tried for the peanut export model were tried also for the peanut oil export model. The results were not as "satisfactory" suggesting the more complex nature of the world peanut oil market. Therefore more investigation should be made in the future.

Table 8-3. OLS Estimated Equations for Senegalese Peanut Exports (continued)

$$PEXP_t = 1010149 + 0.0094\ QS_t - 3.42\ DOMPRI_t - 2.6\ \frac{EXPRICE_t + EXPRICE_{t-1}}{2} - 38110.07\ TIME_t$$

Standard Error	(200259)	(0.0638)	(7.752)	(0.571)	(4613.67)
t-statistics	(5.044)	(0.148)	(-0.441)	(-4.553)	(-8.260)

$R^2 = 0.8760$ $\bar{R}^2 = 0.8430$

Durbin-Watson = 2.406; RMSE = 61344.8

$$PEXP_t = -393679 + 0.00229\ QS_t + 22.75\ DOMPRI_t + 0.91\ \frac{EXPRICE_t + EXPRICE_{t-1}}{2}$$

Standard Error	(241598)	(0.1456)	(16.136)	(0.8707)
t-statistics	(-1.629)	(0.016)	(1.410)	(1.045)

$R^2 = 0.3122$ $\bar{R}^2 = 0.1832$

Durbin-Watson = 0.558; RMSE = 139914

See page 94 for definition of variables.

CHAPTER 9

IMPACTS OF PEANUT PRICE POLICY ON THE RURAL-URBAN TERMS OF TRADE

Two alternative measures are examined in this chapter. The first is the price or net barter terms of trade, which is the comparison of producer prices and the general level of prices confronting small farmers. The second is the income terms of trade, which is the comparison of producers' cash incomes and general price levels.

As Ellis (1982) has pointed out, in both cases, the intention is to discover the trend in the real purchasing power of farmers in Senegal; the net barter terms of trade isolates the pure relative price factor, while the income terms of trade takes into account the additional impact on rural incomes of changes in the volume of marketed output. Like other studies related to the same problem, the net barter terms of trade are calculated by dividing the peanut producer price index by the consumer price index (CPI). Similarly, the income terms of trade are obtained by dividing the gross producer income (peanut price received multiplied by quantity) for peanuts by the same CPI.

The scope of this analysis sets out to describe the specific exchange relationship between farmers and the state within the sphere of producer price policy (Ellis, 1982). It does not purport to analyze fully the rural-urban terms of trade of the overall Senegalese economy which would require a more complex analytical methodology.

The overall price terms of trade declined by 52.11 percent over the period from 1960 to 1980 (Table 9-1). Between 1960 and 1965 the decline was 21.14 percent. Between 1965 and 1970, it was 26.69 percent. Between 1970 and 1975, there was an improvement in the price terms of trade of

Table 9-1. Price Terms of Trade for Senegalese Peanut Growers.

	Producer Price (CFA francs/Kg)	CPI	RPPI
1960	20.90	0.84	148.18
1961	20.90	0.86	144.73
1962	20.90	0.90	138.30
1963	20.90	0.92	135.32
1964	20.90	0.96	129.66
1965	20.90	0.98	127.04
1966	20.90	1.01	123.23
1967	16.79	1.00	100.00
1968	16.79	1.01	98.98
1969	16.79	1.03	97.08
1970	18.03	1.07	100.35
1971	22.00	1.11	118.05
1972	22.00	1.18	111.02
1973	24.00	1.32	108.28
1974	35.00	1.54	135.38
1975	40.00	2.01	118.52
1976	40.00	2.07	115.07
1977	40.00	2.28	104.47
1978	40.00	2.35	101.37
1979	43.00	2.57	99.64
1980	45.00	2.79	96.07

RPPI = Real Producer Price Index

SOURCE = Producer Price BCEAO Journal, Various issues

CPI = Consumer Price Index from Sow, P.A. (1983, page 80).

18.17 percent. Between 1975 and 1980, the decline in the price terms of trade was 22.45 percent. From the above figures it appears that, although some improvement in the price terms of trade occurred during the first half of the 1970's, the improvement was nowhere near sufficient to regain the ground lost earlier.

The overall income terms of trade demonstrated a very large decline from 1960 to 1980 (Table 9-2). The estimated magnitude of the decline was 81.73 percent. Between 1960 and 1965, there was an improvement in the income terms of trade of 10.28 percent. Between 1965 and 1970, the decline in the income terms of trade was 83.69 percent. Between 1970 and 1975, again, the income terms of trade improved about 111 percent before experiencing a decline of 119.32 percent between 1975 and 1980.

Like Ellis (1982) who investigated the agricultural price policy in Tanzania, we came up with similar conclusions for Senegal. The analysis of the peanut price policy in Senegal reveals a major divergence between the stated aim of development strategy and the results achieved during the 1960's and 1970's. The divergence takes the form of progressive deterioration in the real levels of return to agricultural production. The magnitude of the deterioration has widespread implications for the Senegalese economy.

a. The decline in the peanut terms of trade of the rural economy was incompatible with raising rural living standards.

b. The decline in real prices was incompatible with the realization of sustained increases in agricultural productivity and marketed output.

c. The two points above indicate an incompatibility of the peanut price policy with the foreign exchange requirements (demands) of the national economy.

Table 9-2. Income Terms of Trade for Senegalese Peanut Growers.

	Producer Income (in 000 CFA)	CPI	RPI	RPI Index
1960	18642.80	0.84	22193.81	131.53
1961	20795.50	0.86	24180.81	143.30
1962	18684.60	0.90	10760.67	123.02
1963	19896.80	0.92	21626.96	128.17
1964	21297.10	0.96	22184.48	131.47
1965	23449.80	0.98	23928.37	141.81
1966	17911.30	1.01	17733.96	105.10
1967	16873.95	1.00	16873.95	100.00
1968	13767.80	1.01	13631.48	80.78
1969	13247.31	1.03	12861.47	76.22
1970	10493.46	1.07	9806.97	58.12
1971	21670.00	1.11	19522.52	115.70
1972	12540.00	1.18	10627.12	62.98
1973	15768.00	1.32	11945.45	70.79
1974	34335.00	1.54	22295.45	132.13
1975	57360.00	2.01	28537.31	169.12
1976	47440.00	2.07	22917.87	135.82
1977	20320.00	2.28	8912.28	52.82
1978	42040.00	2.35	17889.36	106.02
1979	18939.00	2.57	11260.31	66.73
1980	23445.00	2.79	8403.23	49.80

RPI = Real Producer Income.

For the purpose of comparison an attempt is made to investigate the purchasing power of urban workers based on the minimum wage. The results reveal that between 1960 and 1980 the terms of trade for urban workers increased by 0.77 percent (Table 9-3). Between 1960 and 1965 there was a decrease in the price terms of trade of 6.19 percent. Between 1965 and 1970 there was an increase of 5.44 percent in the price terms of trade. The increase was 13.56 percent between 1970 and 1975.

The overall conclusion is that the conditions of farmers are deteriorating year after year while the conditions of non-skilled urban workers has been relatively stable over the period from 1960 to 1980. Agriculture employs 65 to 70 percent of the country's labor force. It is not surprising to see many farmers migrating to the cities in order to stabilize their income like non-skilled urban workers. As Eicher et. al. (1970) and Byerlee (1974) have indicated, various price distortions such as high urban wage rates and low agricultural prices act to increase rural-urban income differentials and increase migration.

As Todaro (1977) has pointed out individuals migrate because they want to maximize their expected income. Thus, two main economic factors are involved in the decision of a person to migrate:

- the urban-rural wage differential that exists for people of his skill and education level,
- the probability that he will be successful in securing an urban job.

We stated earlier that urban workers earning the minimum wage were better off than farmers. Put another way, when the year 1980 is considered, the comparison of earnings between rural and urban workers based on the minimum wage for the latter and the peanut price for the

Table 9-3. Evolution of the Minimum Wage for Senegalese Non-Skilled Workers, 1960-1980.

	MW	RMW	RMWI
1960	40.0	47.62	108.23
1961	44.0	51.16	116.27
1962	44.0	48.89	111.11
1963	44.0	47.83	108.70
1964	44.0	45.83	104.16
1965	44.0	44.90	102.04
1966	44.0	43.56	99.00
1967	44.0	44.00	100.00
1968	50.6	50.10	113.86
1969	50.6	49.13	111.66
1970	50.6	47.23	107.48
1971	50.6	45.58	103.59
1972	50.6	42.88	97.45
1973	58.19	44.08	100.18
1974	66.91	43.45	98.75
1975	107.05	53.26	121.04
1976	107.05	51.71	117.52
1977	107.05	46.95	106.70
1978	107.05	45.55	103.52
1979	133.81	52.07	118.34
1980	133.81	47.96	109.00

MW = Minimum Wage in FCFA.
RMW = Minimum Wage divided by the CPI.
RMWI = Real minimum wage index (1967 = 100,0).

Source = BCEAO, various issues (For minimum wage).

former shows that the earnings of urban workers are three times higher than earnings of rural workers, ceteris paribus. In this case, then, according to Todaro's model, an individual living in rural areas will be behaving rationally if he moves to urban areas even if there is only 33 percent change of getting a job. Although the model has its limitations, what is obvious is that the greater the difference between the levels of rural and urban earnings the more likely a person will be to migrate.

The overall conclusion coming from the whole analysis is that there should be increasing efforts on the part of the Senegalese government toward increasing incentives in rural areas. This will have at least two effects; first, it will discourage farmers from migrating, and second, will encourage recent migrants already in urban centers to return to rural areas thereby increasing the overall labor force and agricultural production. However, the desirability of these effects depends on the comparison between the marginal value productivity of labor in urban and rural employment which is beyond the scope of the present study.

CHAPTER 10

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

10.1 Summary and Conclusions

Among the industries that have been strongly affected by structural changes during the seventies and early eighties, the peanut industry is one that continues to draw considerable attention. Not only does the industry provide peanut oil and oilseed cake for human and animal feed, it is also a significant source of income, employment and foreign exchange earnings. Peanuts and peanut oil are traded in highly complex world markets for oilseeds and vegetable oils in competition with other oilseeds that are direct substitutes for peanuts and peanut oil. Peanut prices, output and trade are highly affected. Since Senegal is a major participant in international peanut trade, world market conditions directly affect the country's domestic peanut industry. Because peanut production in Senegal involves a high proportion of the country's labor force, it is important to know the degree of responsiveness of peanut growers and the impact of peanut pricing policy on the welfare of producers and the total population.

This study investigates briefly key factors involved in the Senegalese peanut sector, both domestically and at the international level. On the international side, Senegal plays an important role in the world peanut market with respect to production, consumption and trade. Over the period 1977-1982, Senegal ranks fifth in world peanut production, fifth in consumption of peanut oil, seventh in peanut exports, and first in peanut oil exports.

Peanuts and peanut oil are facing increasing competition from various substitutes in world oilseed markets. This is reflected in the

correlation matrices of oilseed prices. World consumers tend to shift away from an oil whose price had temporarily risen (thereby causing its price to fall eventually) and to increase the volume of demand for an oil which had become relatively cheaper (thereby strengthening the price of the substitute oil). Soybeans represent the closest substitute for peanuts in world markets, with a price correlation coefficient of 0.96 followed by palm-kernel, linseed and copra, with correlation coefficients of 0.89, 0.88 and 0.85, respectively. In world vegetable oil markets, it was found that palm-kernel oil was the closest substitute for peanut oil, with a price correlation coefficient of 0.96, followed by soybean oil, linseed oil and coconut oil with respectively 0.93, 0.85 and 0.825. This degree of substitutability is confirmed by another correlation matrix from Oil World, Hamburg.

Furthermore, an attempt was made to investigate the Senegalese exports for both peanut and peanut oil. The results from the peanut export model revealed that the world peanut market is more complex than reflected by any of the different models tried. The inclusion of time as a proxy for the relevant variables not included in the different models attempted results in statistically significant R^2 values. However, the time variable dominates the estimated equations and affects the direction of the signs of the other independnet variables. Therefore, further research is needed to develop useful, estimated equations of export supply response for Senegalese peanuts. On the other hand, the results from the peanut oil export model were not as "satisfactory" suggesting the more complex nature of the world peanut oil market. Therefore, more investigation should be made in the future.

The projections of the peanut oil imports by France, Italy and the EEC indicate that peanut oil imports will be increasing in the future in these countries, but the rate of increase will not be very significant in France and the EEC. The annual percentage increase for Italy was found to be 5.9, leading to the conclusion that higher exports of Senegalese peanut oil may be to countries which, up to the present time, have imported a very small proportion of Senegalese peanut oil.

Domestic peanut oil demand projections for Senegal indicate that consumption of peanut oil will be increasing for years to come with increasing population and per capita income levels. In order to meet domestic demand and provide supplies for export, the government can stimulate sustained increases in peanut production by increasing incentives for people living in rural areas and improving the oil content of the peanut produced.

Investigation of the peanut oil demand model revealed that in Senegal peanut oil is a normal good. Both domestic price and income reflect the expected signs. The results indicate that domestic peanut oil demand is price inelastic (0.3432), so that total income to producers of peanut oil decreases with increases in supply quantities. Consequently, the sales of peanut oil to consumers at substantially subsidized prices will not in itself induce significant expansion of the industry. This may be an important reason why the country's oil mills are having financial difficulties.

The income elasticity of domestic demand was found to be low as expected because peanut oil is a basic food in the Senegalese dietary system. The stability of the national supply model was investigated by use of the Chow test. The test indicates justification for use of the entire time series (1960-1980) for estimation purpose.

Analysis was made of the specific exchange relationship between farmers and the state within the sphere of producer price policy for peanuts. The results indicate that in real terms there has been a decline in both the price and the income derived from peanut farming while urban workers experienced stable conditions. Reference to the Todaro model indicates that an individual living in a rural area who wants to migrate to an urban center would be behaving rationally even if there were only a 33 percent chance for him to secure a job. The future of peanut producers is gloomy unless there are increasing efforts on the part of the government to increase incentives and welfare for people living in rural areas.

10.2 Recommendations

Because the market share of peanut oil in France and the EEC has been decreasing relative to sunflower oil and other vegetable oils, the following recommendations seem relevant.

1. The Senegalese government should formulate measures to stimulate steady production and supply patterns for Senegalese peanuts. This does not mean that peanut acreage should be increased at the expense of food crop acreage. Rather, peanut productivity should be raised by increasing farmers incentives to adopt new proposed practices. This will help place peanuts on a more competitive keel with sunflower in the French market and with soybeans in the world market.

2. In connection with the point above, Senegal will have to increase its storage capacity for orderly marketing of its peanut exports in accordance to world peanut prices. This will help the country to meet regular demand from the EEC countries.

3. The SONACOS and SEIB companies which market Senegalese peanut oil production should draw up and pursue aggressive sales promotion programs to widen the market outlets in European countries, especially France. Also, this should be extended to West African countries since Senegal has comparative advantage in serving those markets. Nigeria is no longer a net peanut oil exporter. Peanut oil exported by Mali and Niger over the period 1977 and 1982 (United States Department of Agriculture) is not very significant (6 percent and 0.5 percent of the Senegalese peanut oil exports over the period). Peanut oil exports from Gambia represents only 12.6 percent of Senegalese exports. Bilateral trade agreements with the other African countries that are not peanut oil producers should be considered. This will require joint action by SONACOS and SEIB.

4. In order to increase the exports of oil cake in the EEC, Senegal should step up efforts for complete control of aflatoxin to meet or exceed the EEC standards of tolerance. Continuous efforts on research leading to complete elimination of aflatoxin should be carried out.

5. Research and implementation programs to increase the oil content of the Senegalese peanut harvest should be given priority.

6. Research on ways to decrease the vulnerability of the country to variations in rainfall is needed. The irrigation dams now being constructed are a good step in this direction.

7. Studies on peanut production costs at the farm level should be carried out to determine whether the actual price policy encourages increased purchase of inputs on the part of farmers.

8. Ways to decrease transportation cost of peanuts from the secco (storage facility in rural areas) to the central point in DAKAR should be

examined. In this connection, studies are needed of efficient ways to implement price differentials among regions without affecting farmers welfare.

9. It is recommended that the government eliminate the subsidized price of peanut oil, because under the present situation (demand inelastic) it is causing the major financial problems the oil mills are facing.

Appendix 1

Leading Countries in Production and Trade of Peanuts and Peanut Oil, 1977 - 1982.

Tables 1 and 2. World's Leading Peanut Producers and Exporters.

Tables 3 and 4. World's Largest Peanut Oil Producers and Exporters.

Tables 5 and 6. World's Largest Peanut and Peanut Oil Importers.

Tables 1 and 2

World's Leading Peanut Producers and Exporters, 1977 - 1982[a]

	Production			Exports	
	Country	Production		Country	Exports
1	India	34,783	1	United States	2,284
2	China	18,375	2	Sudan	536
3	United States	9,693	3	China	487
4	Sudan	5,073	4	Argentina	481
5	Senegal	4,488	5	South Africa	376
6	Indonesia	4,261	6	Senegal	335
7	Nigeria	2,987	7	Gambia	258
8	Burma	2,662	8	India	230
9	Brazil	2,230	9	Brazil	167
10	Argentina	1,947	10	West Germany	148
11	Zaire	1,870	11	Netherlands	119
12	South Africa	1,532	12	Thailand	114
13	Cameroun	1,010	13	Malawi	101
14	Thailand	743	14	Egypt	74
15	Zimbabwe	677	15	Australia	55

a. Based on figures in Appendix 2.
Unit = thousand metric tons.

Tables 3 and 4

World's Largest Peanut Oil Producers and Exporters, 1977 - 1982[a]

	Production			Exports	
	Country	Production		Country	Exports
1	India	7,996	1	Senegal	555
2	China	2,863	2	Brazil	412
3	Senegal	1,293	3	Argentina	341
4	Sudan	1,261	4	Sudan	166
5	Nigeria	653	5	United States	140
6	Burma	611	6	China	138
7	Brazil	459	7	Netherlands	120
8	United States	426	8	Belgium	119
9	Argentina	332	9	France	101
10	France	243	10	Gambia	70
11	South Africa	243	11	South Africa	67
12	Zaire	206	12	Mali	34
13	Mali	143	13	Italy	32
14	Indonesia	120	14	West Germany	26
15	Gambia	111	15	Malaysia	17

a. Based on figures in Appendix 2.
Unit = thousand metric tons.

Tables 5 and 6

World's Largest Peanut and Peanut Oil Importers, 1977-1982[a]

	Peanut Imports			Peanut Oil Imports	
	COUNTRY	IMPORTS		COUNTRY	IMPORTS
1	France	975	1	France	1200
2	United Kingdom	622	2	West Germany	216
3	Netherlands	613	3	Belgium	213
4	Canada	561	4	Italy	168
5	West Germany	505	5	Netherlands	141
6	Japan	453	6	Switzerland	101
7	Italy	314	7	United Kingdom	95
8	USSR	243	8	Venezuela	84
9	Portugal	235	9	Nigeria	64
10	United States	184	10	Canada	32

a. Based on figures in Appendix 2.
Unit = thousand metric tons.

APPENDIX 2

Source: Foreign Agriculture Circular: Oilseeds and Products, November, 1982.

Table 1

Area Planted to Peanuts by Country
(In 1,000 Hectares)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Argentina	428	393	279	197	166	120
Australia	30	37	32	27	33	35
Bangladesh	23	25	23	24	25	25
Benin	73	75	75	75	75	75
Brazil	253	286	320	235	230	200
Burma	564	523	456	525	525	525
Burundi	20	19	28	30	30	30
Cameroon	341	387	358	350	350	350
Cent. African Rep.	105	105	105	105	105	105
Chad	101	101	101	101	101	101
China, Mainland	1,688	1,768	2,074	2,339	2,500	2,500
Dominican Rep.	45	40	35	28	25	21
Egypt	18	20	18	18	18	18
Gambia	112	118	100	109	110	110
Ghana	109	109	101	80	85	85
Guinea	31	31	31	31	31	31
Guinea-Bissau	80	80	80	80	80	80
India	7,029	7,433	7,165	6,905	7,250	7,200
Indonesia	506	473	506	519	500	510
Italy	1	1	1	1	1	1
Ivory Coast	52	59	61	63	64	64
Japan	35	35	34	33	32	30
Korea, Rep. of	10	14	14	12	10	13
Madagascar	38	40	37	37	36	36
Malaysia	6	6	6	6	6	6
Mali	97	97	97	97	97	97
Mexico	38	42	38	40	47	45
Morocco	19	28	26	28	32	27
Mozambique	200	200	200	200	200	200
Niger	174	195	145	169	150	140
Nigeria	820	600	600	600	600	625
Pakistan	51	46	41	47	50	50
Paraguay	23	24	24	25	25	25
Philippines	48	54	55	39	54	54
Senegal	1,079	1,150	1,097	1,079	1,000	1,000
South Africa	214	213	280	243	203	225
Sudan	1,104	982	988	926	1,000	1,000
Taiwan	53	58	54	53	56	56
Tanzania	72	72	72	72	72	72
Thailand	106	97	102	108	111	125
Togo	45	45	45	45	45	45
Turkey	22	22	25	19	25	26
Uganda	238	102	83	102	125	150

Table 1 (cont.)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
United States	614	611	615	566	604	514
Upper Volta	140	140	140	140	140	140
USSR	1	1	1	1	1	1
Venezula	16	11	12	12	16	20
Zaire	457	460	465	480	460	460
Zambia	75	22	26	33	35	35
Zimbabwe	253	253	190	240	255	260
TOTAL	17,657	17,703	17,461	17,294	17,791	17,633

Table 2

Peanut Production by Country
(In 1,000 Metric Tons)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Argentina	372	672	295	243	215	150
Australia	39	62	39	43	57	52
Bangladesh	28	28	26	24	25	25
Benin	60	64	70	70	70	70
Brazil	340	465	545	310	290	280
Burma	457	384	337	484	500	500
Burundi	27	25	36	38	40	40
Cameroon	267	116	156	157	157	157
Cent. African Rep.	85	85	85	85	85	85
Chad	70	70	70	70	70	70
China, Mainland	1,950	2,377	2,822	3,600	3,826	3,800
Dominican Rep.	50	47	45	36	29	23
Egypt	30	33	33	32	33	33
Gambia	117	151	75	70	125	125
Ghana	75	45	45	23	27	27
Guinea	31	32	30	30	30	30
Guinea-Bissau	55	35	35	20	20	20
India	6,087	6,208	5,768	5,020	6,200	5,500
Indonesia	743	708	672	722	694	722
Italy	2	2	2	1	1	1
Ivory Coast	49	50	52	53	55	55
Japan	69	62	67	55	61	50
Korea, Rep. of	23	32	32	25	23	23
Madagascar	34	40	34	35	36	36
Malawi	16	35	43	50	75	75
Malaysia	14	14	14	14	14	14
Mali	128	126	116	92	80	80
Mexico	72	67	55	60	75	50
Morocco	8	26	27	35	18	35
Mozambique	70	80	75	75	75	75
Niger	82	97	89	101	85	70
Nigeria	302	341	539	560	610	635
Pakistan	72	45	50	57	72	74
Paraguay	25	23	25	25	25	25
Philippines	37	50	50	30	50	50
Senegal	671	1,053	600	499	790	875
South Africa	299	179	347	307	114	286
Sudan	1,021	813	852	707	850	830
Taiwan	77	92	86	86	90	90
Tanzania	74	74	74	74	74	74
Thailand	106	102	120	129	136	150
Togo	27	35	30	30	30	30
Turkey	50	52	58	41	56	60
Uganda	187	80	65	80	100	120

Table 2 (cont.)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
United States	1,690	1,793	1,800	1,044	1,809	1,557
Upper Volta	85	70	69	70	77	77
USSR	1	1	1	1	1	1
Venezula	26	17	20	18	16	25
Zaire	307	310	313	320	310	310
Zambia	75	22	27	35	35	35
Zimbabwe	105	114	83	130	115	130
TOTAL	16,687	17,504	16,999	15,916	18,451	17,707

Table 3

Peanut Exports and Imports by Country
(In 1,000 Metric Tons)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
EXPORTS						
Argentina	49	137	92	74	72	57
Australia	3	3	17	8	10	14
Brazil	20	26	38	43	20	20
Cameroon	1	6	1	3	3	3
China, Mainland	30	40	42	150	100	125
Egypt	18	8	12	12	12	12
France	2	1	1	2	1	1
Gambia	35	61	47	35	40	40
Germany (FRG)	3	26	28	31	30	30
Guinea-Bissau	11	7	11	7	7	7
India	0	27	26	71	46	60
Indonesia	2	2	7	1	0	0
Madagascar	1	1	1	1	1	1
Malawi	10	17	17	17	20	20
Malaysia	1	0	0	0	0	0
Mali	14	3	2	1	1	1
Mexico	1	2	1	0	0	0
Mozambique	3	5	3	3	3	3
Netherlands	25	12	17	21	22	22
Paraguay	1	3	4	4	4	4
Senegal	50	50	75	70	45	45
South Africa	90	26	100	67	36	57
Sudan	197	67	32	80	80	80
Taiwan	0	0	0	2	3	3
Thailand	26	23	4	22	14	25
Turkey	4	4	2	6	6	8
United Kingdom	9	2	0	0	0	0
United States	465	518	479	228	261	333
Zimbabwe	0	1	4	3	4	4
TOTAL	1,071	1,078	1,063	962	841	975

Table 3 (cont.)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
IMPORTS						
Australia	7	0	0	3	2	5
Belgium	4	1	3	2	2	2
Canada	95	90	77	101	98	100
France	259	195	163	117	121	120
Germany (FRG)	79	77	88	81	90	90
Indonesia	0	7	10	13	50	53
Italy	74	90	33	41	38	38
Japan	80	84	80	84	60	65
Korea, Rep. of	7	9	14	16	2	5
Malaysia	18	7	14	10	10	10
Mexico	0	0	0	2	0	0
Netherlands	92	88	106	107	110	110
Nigeria	12	1	0	0	0	0
Portugal	54	49	6	1	75	50
Senegal	0	0	60	0	0	0
South Africa	0	14	6	1	75	50
Sweden	2	2	2	2	2	2
Switzerland	35	30	19	15	20	20
Taiwan	0	0	1	0	0	0
United Kingdom	104	125	106	90	97	100
United States	0	0	0	182	1	1
USSR	49	30	40	48	38	38
Venezuela	25	2	1	2	4	4
TOTAL	996	901	829	920	829	827

Table 4

Peanut Ending Stocks by Country
(In 1,000 Metric Tons)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Argentina	4	73	10	13	13	6
Australia	6	17	9	7	9	7
Dominican Rep.	3	3	3	3	3	3
France	4	5	0	3	3	2
India	200	200	200	100	150	150
Japan	8	9	8	14	21	12
Korea, Rep. of	5	2	1	11	2	1
Mexico	8	11	5	4	13	7
Netherlands	0	3	5	4	5	6
Nigeria	0	0	0	15	25	25
Portugal	0	6	4	3	3	3
Senegal	0	0	20	10	0	0
South Africa	7	13	17	80	1	1
Taiwan	0	5	3	3	4	4
Thailand	39	10	15	7	13	20
Turkey	1	1	2	2	2	3
United Kingdom	0	10	15	8	6	6
United States	264	266	285	187	343	295
Zimbabwe	16	16	16	16	16	16
TOTAL	565	660	618	490	632	567

Table 5

Peanut Oil Production by Country
(In 1,000 Metric Tons)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Argentina	75	99	65	38	33	22
Australia	3	2	3	2	3	3
Bangladesh	6	6	6	5	5	5
Benin	7	7	8	8	8	8
Brazil	65	100	128	54	57	55
Burma	108	94	79	90	120	120
Burundi	2	2	2	2	2	2
Cameroon	9	9	11	11	11	11
Cent. African Rep.	10	10	10	10	10	10
Chad	8	8	8	8	8	8
China, Mainland	307	380	452	576	576	572
Dominican Rep.	13	13	12	10	8	6
France	74	48	42	25	27	27
Gambia	26	28	12	11	27	27
Guinea	4	4	4	4	4	4
Guinea-Bissau	5	3	3	2	2	2
India	1,366	1,441	1,339	1,180	1,430	1,240
Indonesia	47	23	9	14	13	14
Italy	19	22	6	10	9	9
Ivory Coast	12	12	12	14	14	14
Madagascar	4	4	4	4	4	4
Malawi	1	2	3	4	6	6
Malaysia	5	3	4	3	3	3
Mali	26	29	28	22	19	19
Mexico	1	1	1	1	1	1
Mozambique	8	9	8	8	8	8
Niger	8	3	2	2	2	0
Nigeria	4	12	173	144	157	163
Pakistan	14	9	8	9	11	12
Paraguay	4	3	3	3	3	3
Portugal	18	20	4	1	34	22
Senegal	150	390	130	84	247	292
South Africa	43	27	52	37	31	53
Sudan	126	228	251	176	210	270
Switzerland	10	8	12	10	13	13
Taiwan	9	10	9	8	8	0
Tanzania	8	8	8	8	8	8
Togo	3	4	4	4	4	4
Turkey	4	4	4	4	4	6
Uganda	21	9	7	9	11	13
United States	66	74	81	63	79	63
Upper Volta	20	17	17	17	19	19
Venezuela	14	6	7	6	5	10
Zaire	34	35	35	34	34	34
Zambia	8	3	3	4	4	4
Zimbabwe	2	2	1	3	5	4
TOTAL	2,788	3,242	3,081	2,752	3,307	3,203

Table 6

Peanut Oil Domestic Consumption by Country
(In 1,000 Metric Tons)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Argentina	2	0	0	0	0	0
Australia	3	4	3	3	2	2
Bangladesh	6	6	6	5	5	5
Belgium	13	16	19	12	15	18
Benin	7	7	8	8	8	8
Brazil	4	19	8	4	7	5
Burma	108	94	79	90	120	120
Burundi	2	2	2	2	2	2
Cameroon	9	9	11	11	11	11
Canada	7	6	5	4	5	5
Cent. African Rep.	10	10	10	10	10	10
Chad	8	8	8	8	8	8
China, Mainland	300	356	424	546	552	547
Dominican Rep.	15	11	12	10	8	6
France	223	251	265	194	190	207
Gambia	11	19	0	1	15	15
Cermany (FRC)	30	34	32	31	30	30
Cuinea	4	4	4	4	4	4
Cuinea-Bissau	5	3	3	2	2	2
India	1,371	1,438	1,339	1,180	1,430	1,240
Indonesia	47	23	9	14	13	14
Italy	46	53	54	18	20	20
Ivory Coast	12	12	14	14	14	14
Madagascar	4	4	4	4	4	4
Malawi	1	2	3	4	6	6
Malaysia	0	3	5	1	1	1
Mali	18	22	24	17	14	14
Mexico	1	1	1	1	1	1
Mozambique	8	9	8	8	8	8
Netherlands	2	3	4	3	4	4
Niger	8	1	1	2	2	0
Nigeria	24	38	177	148	162	168
Pakistan	14	9	8	9	11	12
Paraguay	4	3	3	3	3	3
Portugal	18	20	4	1	34	22
Senegal	14	274	45	56	152	197
South Africa	24	26	34	30	31	33
Sudan	109	188	232	146	180	240
Sweden	0	1	0	0	0	0
Switzerland	24	28	32	17	33	33
Taiwan	9	10	9	8	8	0
Tanzania	8	8	8	8	8	8
Thailand	10	11	11	11	10	10
Togo	3	4	4	4	4	4
Turkey	4	4	6	4	4	6

Table 6 (cont.)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
Uganda	21	9	7	9	11	13
United Kingdom	15	15	17	17	16	15
United States	89	53	81	51	52	47
Upper Volta	20	17	17	17	19	19
Venezuela	80	8	11	10	9	14
Zaire	34	35	35	34	34	34
Zambia	8	3	3	4	4	4
Zimbabwe	2	5	1	2	5	4
TOTAL	2,819	3,199	3,108	2,800	3,301	3,217

Table 7

Peanut Oil Exports and Imports by Country
(In 1,000 Metric Tons)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
EXPORTS						
Argentina	63	115	70	38	33	22
Australia	0	0	0	0	1	1
Belgium	11	18	24	22	22	22
Brazil	61	81	120	50	50	50
China, Mainland	7	24	28	30	24	25
France	17	19	15	10	20	20
Gambia	15	9	12	10	12	12
Germany (FRG)	3	5	7	3	5	3
India	5	3	0	0	0	0
Italy	3	5	4	12	4	4
Malaysia	7	2	2	2	2	2
Mali	8	7	4	5	5	5
Netherlands	8	13	30	19	25	25
Niger	0	2	1	0	0	0
Senegal	136	116	85	28	95	95
South Africa	19	1	19	8	0	20
Sudan	17	40	19	30	30	30
Sweden	1	0	1	1	1	1
United States	57	18	7	22	18	18
TOTAL	438	478	448	290	347	355

Table 7 (cont.)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
IMPORTS						
Australia	0	2	0	1	0	0
Belgium	25	35	42	33	38	40
Canada	7	6	5	4	5	5
Dominican Rep.	2	0	0	0	0	0
France	186	221	249	163	181	200
Germany (FRG)	38	41	39	30	35	33
India	10	0	0	0	0	0
Italy	30	46	42	20	15	15
Malaysia	2	2	3	0	0	0
Netherlands	10	17	34	22	29	29
Nigeria	20	26	4	4	5	5
South Africa	0	0	1	1	0	0
Sweden	1	1	1	1	1	1
Switzerland	14	20	20	7	20	20
Turkey	0	0	2	0	0	0
United Kingdom	15	15	17	17	16	16
Venezuela	66	2	4	4	4	4
Zimbabwe	0	3	0	0	0	0
TOTAL	426	437	463	307	349	367

Table 8

Peanut Oil Ending Stocks by Country
(In 1,000 Metric Tons)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83
ENDING STOCKS						
Argentina	21	5	0	0	0	0
Belgium	1	2	1	0	1	1
Dominican Rep.	0	2	2	2	2	2
France	20	19	30	14	12	12
Germany (FRG)	5	7	7	3	3	3
Italy	0	10	0	0	0	0
Netherlands	0	1	1	1	1	1
Thailand	2	2	2	1	1	1
United States	21	24	17	7	16	14
Zimbabwe	0	0	0	1	1	1
TOTAL	70	72	60	29	37	35

Appendix 3

Supply and Demand Data for Peanuts and Peanut Oil in Senegal, 1960 - 1980.

Source: Senegal, Ministry of Rural Development and BCEAO.

Table 1

National and Official Supply Data for Peanuts.

YEAR	RF	ACR	RPP	PRO	QS
1960	643	977	24.88	892	812
1961	789	1,026	24.30	995	893
1962	862	1,013	23.22	894	773
1963	943	1,084	22.72	952	804
1964	757	1,055	21.77	1,019	870
1965	681	1,112	21.33	1,122	1,006
1966	629	1,114	20.69	857	755
1967	881	1,164	16.79	1,005	834
1968	576	1,191	16.62	820	623
1969	660	963	16.30	789	705
1970	684	1,050	16.85	582	466
1971	607	1,060	19.82	985	893
1972	349	1,071	18.64	570	511
1973	565	1,025	18.18	657	570
1974	583	1,052	22.73	981	883
1975	645	1,312	19.90	1,434	1,302
1976	573	1,295	19.32	1,186	1,074
1977	415	1,161	17.54	508	459
1978	600	1,154	17.02	1,051	902
1979	482	1,048	16.73	673	422
1980	436	1,066	16.13	521	191

RF = rainfall in millimeters
ACR = acreage in 1000 hectares
RPP = real producer prices (deflated by CPI of Chapter 8) in FCFA per kilogram
PRO = Total production in 1000 metric tons
QS = Total sales (official channels) in 1000 m.t.

Table 2

Peanut Supply Data for Sine-Saloum

YEAR	RF	ACR	RPP	QS
1960	601	429.7	24.88	371.7
1961	664	471	24.30	373.2
1962	592	482.5	23.22	367.9
1963	644	475.1	22.72	351.5
1964	876.5	495.7	21.77	432.0
1965	655	499.0	21.33	480.8
1966	180.6	514.7	20.69	448.0
1967	907	531.5	16.79	346.5
1968	441	522.2	16.62	328.1
1969	654	389.3	16.30	327.9
1970	482	435.7	16.85	229.2
1971	771	450.4	19.82	396.7
1972	415	454.9	18.64	317.7
1973	464	458.9	18.18	265.2
1974	564	430.0	22.73	388.0
1975	694	537.7	19.90	565.0
1976	540	599.7	19.32	518.6
1977	415	522.3	17.54	198.4
1978	941	483.0	17.02	348.5
1979	571	380.1	16.73	177.0

RF = rainfall in millimeters
ACR = acreage in 1000 hectares
RPP = real producer prices in FCFA/kilo.
QS = quantity supplied through official channels inl 000 metric tons.

Table 3

Peanut Supply Data for Thies

YEAR	ACR	MS	RPP	QS
1960	130.1	44.35	24.88	120.5
1961	132.0	45.35	24.30	132.1
1962	133.2	46.70	23.22	101.2
1963	126.3	51.40	22.72	115.5
1964	137.0	43.00	21.77	100.7
1965	146.0	52.70	21.33	131.9
1966	121.1	41.93	20.69	85.0
1967	157.3	68.28	16.79	132.2
1968	169.2	45.14	16.62	86.0
1969	151.0	77.62	16.30	100.1
1970	136.3	33.36	16.85	64.9
1971	155.5	81.01	19.82	154.4
1972	158.8	13.17	18.64	14.5
1973	151.0	103.35	18.18	83.1
1974	154.8	87.52	22.73	134.8
1975	195.8	98.14	19.90	189.8
1976	160.5	49.36	19.32	107.6
1977	135.0	21.49	17.54	30.0
1978	105.9	117.66	17.02	109.0
1979	167.7	62.36	16.73	42.5

MS = millet - sorghum in 000 metric tons

Table 4

Peanut Supply Data for Diourbel-Louga

YEAR	RF	SEED	RPP	QS
1960	631	17.83	24.88	185.08
1961	507	17.84	24.30	237.23
1962	483.5	18.34	23.22	159.83
1963	515	18.85	22.72	200.95
1964	610.5	20.72	21.77	179.55
1965	506	24.41	21.33	246.88
1966	488	21.91	20.69	91.71
1967	762.5	23.41	16.79	238.24
1968	288.5	24.98	16.62	111.17
1969	471.5	24.68	16.30	169.53
1970	335.5	24.81	16.85	64.05
1971	430	28.54	19.82	208.59
1972	307.5	29.51	18.64	53.36
1973	289.5	32.38	18.18	100.13
1974	439.5	28.50	22.73	209.66
1975	360	41.02	19.90	371.47
1976	363.5	33.16	19.32	272.60
1977	276	37.60	17.54	123.41
1978	451	43.21	17.02	261.79
1979	362	41.75	16.73	107.31

Table 5

Peanut Supply Data for Casamance

YEAR	RF	SEED	RPP	QS
1960	1,079.0	6.49	24.88	101.58
1961	1,253.5	6.31	24.30	109.93
1962	1,319	6.36	23.22	101.81
1963	1,219	6.36	22.72	93.37
1964	1,310	6.88	21.77	115.13
1965	1,458	7.17	21.33	106.88
1966	1,251	7.80	20.69	92.48
1967	1,560	9.16	16.79	84.94
1968	830	8.34	16.62	82.36
1969	1,198	9.16	16.30	78.29
1970	1,136	10.59	16.85	84.41
1971	983	12.59	19.82	109.34
1972	702	14.43	18.64	102.35
1973	1,118	13.33	18.18	100.72
1974	1,110	13.84	22.73	110.62
1975	1,322	15.92	19.90	117.65
1976	1,282	13.47	19.32	120.33
1977	813	13.36	17.54	76.43
1978	1,258	13.62	17.02	114.88
1979	968	14.01	16.73	59.55

Seed is in 1000 metric tons

Table 6

Peanut Supply Data for Senegal-Oriental

YEAR	ACR	RPP	QS
1960	31.02	24.88	29.19
1961	35.20	24.30	36.21
1962	38.20	23.22	38.20
1963	43.38	22.72	37.23
1964	33.10	21.77	37.24
1965	34.50	21.33	34.00
1966	35.06	20.69	34.74
1967	36.16	16.79	24.69
1968	32.15	16.62	14.31
1969	29.00	16.30	20.86
1970	44.25	16.85	4.17
1971	41.08	19.82	22.41
1972	43.68	18.64	23.46
1973	46.76	18.18	20.31
1974	41.06	22.73	38.01
1975	58.89	19.90	53.21
1976	50.66	19.32	53.81
1977	42.15	17.54	30.58
1978	64.10	17.02	64.06
1979	61.09	16.73	34.94

Table 7

Peanut Oil Demand Data for Senegal

YEAR	QD	DOMPRI	POP	INCOME
1961	26,697	113,953	3,178	134,200
1962	31,244	108,889	3,248	142,100
1963	30,278	106,522	3,320	147,900
1964	31,807	102,083	3,393	157,300
1965	34,953	100,000	3,467	165,000
1966	33,619	97,030	3,543	170,700
1967	34,611	98,000	3,622	170,600
1968	28,661	97,030	3,701	185,100
1969	35,460	95,146	4,292	182,300
1970	35,919	91,589	4,391	205,500
1971	41,412	88,288	4,492	213,700
1972	47,839	83,051	4,508	232,600
1973	50,120	74,242	4,728	235,400
1974	40,844	63,636	4,851	281,200
1975	41,448	98,507	4,977	346,400
1976	37,938	95,652	5,107	391,300
1977	52,000	86,842	5,250	420,900
1978	95,000	84,255	5,397	398,300
1979	50,000	77,043	5,548	476,200
1980	24,000	85,305	5,703	533,600
1981	58,000	111,864	5,863	572,200

QD = peanut oil consumption in metric tons
DOMPRI = domestic prices of peanut oil (deflated) FCFA
POP = population of Senegal in 1000 persons
INCOME = total income of Senegal in 1000 FCA (deflated)

Source: BCEAO, Foreign Agriculture Circular, Gaye and Andersen report, group macroeconomique de planification of the ministry of plan

Table 8

Peanut Exports Data for Senegal

YEAR	PEXP	QS	DOMPRI	EXPRI	TIME
1960	362,003	812,000	24,880	177,024	1
1961	386,080	893,000	24,300	172,907	2
1962	395,680	773,000	23,220	165,222	3
1963	291,666	804,000	22,720	161,630	4
1964	305,516	870,000	21,770	154,896	5
1965	309,779	1,006,000	21,330	149,694	6
1966	425,969	755,000	20,690	145,248	7
1967	257,454	834,000	16,790	146,700	8
1968	347,149	623,000	16,620	145,248	9
1969	137,004	705,000	16,300	142,427	10
1970	73,496	466,000	16,850	183,551	11
1971	46,486	893,000	19,820	176,937	12
1972	19,907	511,000	18,640	166,441	13
1973	4,833	570,000	18,180	148,788	14
1974	18,932	883,000	22,730	127,532	15
1975	15,296	1,302,000	19,900	80,448	16
1976	189,810	1,074,000	19,320	71,739	17
1977	101,950	459,000	17,540	78,728	18
1978	24,286	902,000	17,020	72,553	19
1979	13,037	422,000	16,730	51,984	20
1980	3,899	191,000	16,130	35,305	21

PEXP = Peanut exports in metric tons
QS = Quantity supplied through Oncad marketing board in metric tons
DOMPRI = domestic price of peanut (deflated)
EXPRI = export price of peanut: (FOB) Rotterdam (deflated)

Source: FAO Trade Yearbook, Ministry of Rural Development (Senegal), Pierre Thenevin and J. M. Yung Report, BCEAO Journal.

Table 9

Peanut Oil Exports Data for Senegal

YEAR	POEXP	POPRO	DOMPRI	EXPRI	TIME
1960	114,086	139,364	113,953	297,857	1
1961	125,779	156,993	10,889	290,930	2
1962	118,596	116,856	106,522	278,000	3
1963	103,620	158,670	102,083	271,957	4
1964	129,531	174,821	100,000	260,625	5
1965	142,544	215,620	97,030	243,367	6
1966	146,446	101,985	98,000	236,139	7
1967	162,048	178,556	97,030	238,500	8
1968	198,040	85,431	95,146	236,139	9
1969	116,134	175,908	91,589	231,553	10
1970	146,065	121,558	88,288	308,411	11
1971	71,914	262,165	83,051	297,297	12
1972	229,985	152,092	74,242	279,661	13
1973	77,264	175,032	63,636	250,000	14
1974	104,754	267,602	98,507	214,286	15
1975	196,653	398,492	95,652	156,716	16
1976	256,073	273,834	86,842	128,792	17
1977	227,330	110,578	84,255	124,035	18
1978	76,500	271,828	77,043	129,149	19
1979	137,345	126,656	85,305	83,774	20
1980	73,794	57,945	111,864	66,774	21

POEXP = Peanut oil exports in metric tons
POPRO = Peanut oil production in metric tons
DOMPRI = Domestic price of peanut oil (deflated)
EXPRI = Export price of peanut oil (deflated) FOB Rotterdam

Source: FAO Trade Yearbook, Pierre Thenevin and J. M. Yung Report, BCEAO Journal, Gaye and Andersen Report, FAC USDA.

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AN ECONOMETRIC STUDY OF SUPPLY AND DEMAND FOR PEANUTS AND PEANUT OIL: IMPLICATIONS FOR SENEGALESE AGRICULTURAL POLICY

by

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AN ABSTRACT OF A MASTER'S THESIS

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ABSTRACT

This study investigates supply, demand and equity factors involved in the Senegalese peanut industry at both the domestic and international levels. In the domestic side, different supply models at the national and regional levels were estimated by use of the ordinary least squares corrected by the Cochran-Orcutt procedure whenever the hypothesis of randomness of the errors was violated. In the aggregate, farmers appear to be responsive to peanut prices given their alternative choices. At the regional level, the degree of responsiveness of farmers differs among regions, suggesting the possibility of regional differences in price support levels and other policy-influenced variables.

Investigation and projections of peanut oil demand were made also. The results revealed that peanut oil is a normal good and its consumption will continue to grow in the future as the country's population and disposable income increase. The demand is price inelastic, with positive but relatively low income elasticity.

The exchange relationship between the state and the country's farmers through peanut pricing policy was examined. The results show that under the existing system, pricing policies work to the disadvantage of farmers in terms of real income and purchasing power.

At the international level, Senegal still enjoys a good position in the world peanut market, but in world oilseed markets peanut trade is becoming more vulnerable due to increasing competition by various substitutes. The trends indicate that future growth in Senegalese peanut oil exports will not be very encouraging in France and the EEC. Potentials for increasing sales exist in other countries that hitherto have purchased only small quantities of Senegalese peanut oil.

Suggested solutions are for the government to develop aggressive sales promotion programs in Europe and in African countries, and to seek ways of implementing bilateral trade agreements on quota bases with those countries. For such programs to be successful it is important that Senegal's production be stable. Thus, continuous efforts should be directed toward more agricultural research and provision of more storage facilities. At the same time, farmers' incentives need to be increased so that it is profitable for them to apply the results of research. In order for the country to have a net gain from all the efforts, a more efficient management is needed in the activities of the marketing board, the development agencies and the oil mills in Senegal.