

CHAPTER 1:
THE PEANUT SECTOR
IN SENEGAL

1.1 Introduction

Peanut production in Senegal has experienced a steady decline over the past decades for historical, political, economic and environmental reasons. In order to reverse this downward trend and ensure future growth in peanut output, the government undertook several initiatives among which was the development of agricultural research in collaboration with international organizations. One recent result of this collaboration was the release by the Senegalese Institute of Agricultural Research (ISRA) of a new peanut variety, La Fleur 11, which is expected to improve peanut productivity. The purpose of this study is to conduct an ex-ante evaluation of research on La Fleur 11. The magnitude of the net social benefits from the adoption of this new peanut variety in Senegal will be determined.

1.2 Peanut sector in Senegal

Peanut production and processing represent an important part of the agricultural and economic activities in Senegal. In 1997-98, 788,120 hectares of peanuts were planted, representing 37 percent of the country's total cultivated area. It was the second largest crop after millet (821,238 hectares) (Senegal, Republic of, Ministry of Agriculture, 1998 a). Peanut exports represented 5 percent of total exports in 1997 (IMF, 1998) and 52 percent of agricultural exports in 1998 (FAO, 2001). Peanuts generate 80 percent of farmers' revenues from sales (Gaye, 1999) and are the most important source of foreign exchange (Bravo-Ureta, 1998). This section provides a description of the peanut sector and its problems regarding production, storage and marketing.

1.2.1 Peanut production

In 1996, the varietal map for peanuts in Senegal was subdivided into five agro-climatic regions: the extreme north, the north, the central, the south and the extreme south. These regions cover the following administrative sub-divisions:

- Saint-Louis (only Dagana, Podor and Richard Toll) in the extreme north,
- Louga in the north,
- Thies (except Dakar) and Djourbel in the central,
- Fatick, Kaolack, north of Tambacounda in the south,
- South of Tambacounda, Kolda and Ziguinchor in the extreme south.

The climate and nature of soil differentiate the five agro-climatic regions identified in Senegal. As one moves from north to south, the amount of rainfall and the clay content of soils increase. Different varieties of peanuts have been adapted to these regions depending on the duration of the growth cycle of the plants and on the amount of rainfall in each area. Table 1.1 is a description of these agro-climatic regions according to their climatic characteristics and the peanut varieties that have been adapted to each region. This table represents the entire country, but most of the peanut area is located in the peanut basin, which covers the north, central and part of the south. The majority of peanut varieties are grown for peanut oil production.

Table 1.1: Characteristics of the regions of peanut production in Senegal

	Extreme North (Vallée du Fleuve Sénégal)	North	Central	South	Extreme South
Administrative subdivisions	Saint-Louis (only Dagana, Podor, and Richard Toll)	Louga	Djourbel Thies (except Dakar)	Fatick Kaolack Tambacounda (north) Ziguinchor Kolda	Tambacounda (south) Kolda Ziguinchor
Rainfall (mm/year)	Irrigated	Less than 300	300-500	500-700	700-1100
Duration of peanut plant growth cycle	Middle cycle (90 days)	Short cycle (65-75 days)	Middle cycle (85-95 days)	Long cycle (95-120 days)	Very Long cycle (125 days)
Adapted varieties*	55-437: 90 days La Fleur 11: 90 days	GC8-35: 80 days 55-437: 90 days	55-437: 90 days La Fleur 11: 90 days	73-33: 105 GH119-20:110 days 28-206: 120 days 57-313: 125 days 69-101: 125 days	57-313: 125 days 69-101: 125 days

*: Except GH119-20, which is a confectionery variety, all the other varieties are grown for oil. GH119-20 was imported from the USA. The use of this variety is now declining because it is not well adapted to the climate. It is being replaced by a new variety developed in Senegal, H75-0.
Source: (Ndoye; July 19th, 2000).

The successful development and extension of short-cycle varieties that adapt well to dry conditions reduced the yield difference between the low rainfall and high rainfall zones. Peanuts are produced with an average yield of 900 kg/ha¹ (Senegal, Republic of, Ministry of Agriculture, 1998 a). Peanut supply is inelastic due to the high dependence of farmers' revenues on peanut production and their lack of diversification.

For the period 1982-1996, the average farm size varied between 2.9 hectares and 13.7 hectares and the average land in peanuts varied between 0.4 hectares and 6.5 hectares per farm depending on the regions of production (Bravo-Ureta, Hathie and Thiam, 1998). Thus, Senegalese peanut growers are small farmers.

Production equipment is generally rudimentary and is fully depreciated. It generally consists of non-motorized tools. Labor may be a constraint, especially during the planting, weeding and harvest periods.

The informal market generally provides seeds of old varieties and Sonagraines (Société Nationale d'Approvisionnement en Graines), a public seed distribution company, provides seeds of new or certified varieties. Recently, another institution has been involved in seed distribution, Union Nationale Interprofessionnelle des Semenciers (UNIS), which is an association consisting of private seed providers. Sonagraines and UNIS sell seeds to contracted farmers. The seed supply is insufficient, which limits farmers' peanut income and capacity to purchase productivity enhancing inputs (Crawford et al, 1996). Crawford et al (1996) argue that the seed problem is more a demand problem than a supply problem. They propose several solutions to improve farmers' capacity to purchase seeds: increasing credit availability, enhancing the

¹ According to CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement) researchers, the national peanut yields provided by the government are overestimated

flexibility of the credit payments, promoting non-cropping sources of cash income, promoting sale and availability of certified seeds year round, encouraging competition in seed production and marketing, increasing distribution points and encouraging sales in smaller units.

Farmers have used less fertilizer in recent decades. As a consequence, soil fertility has declined causing peanut yield to fall. In general, inappropriate production practices caused natural resource degradation (soil erosion, desertification) that has been aggravated by declining rainfall and a shorter growing season. As a consequence, arable land declined and output decreased. In some cases, producers offset the decline in soil productivity by employing a millet-peanut rotation.

Farmers seldom use pesticides and fungicides for crop protection except in irrigated areas and in some cases for new varieties. According to Crawford et al (1996), the extension programs do not sufficiently promote the use of these chemicals. Moreover, farmers have inadequate cash reserves and poor access to credit, preventing them from purchasing adequate amounts of inputs.

In conclusion, there is currently a trend towards a decline in peanut output in Senegal. The next section presents the macroeconomic reasons for this output decline.

1.2.2 Peanut marketing

In 1996-97, 76 percent of Senegalese peanut production was sold. The rest was stored for seeds (9 percent), consumed (3 percent) or used for charity, gifts and payments in kind (12 percent) (Gaye, 1997). Peanuts are sold through two markets, the official

(Bravo-Ureta et al, 1998).

market (65 percent of the supply) and the unofficial market (11 percent of the supply)². The unofficial market is quickly developing due to some weaknesses in the official market (lower price, weighing problems, long distances to the collection points, limited access to credit and inputs and so forth). The unofficial market works year round. Most of the peanuts sold on the unofficial market are unshelled (91 percent). However, producers may add value to their production by shelling the peanuts or transforming them into paste or oil and selling them on the unofficial market to intermediates or consumers in rural or urban areas. Producers may illegally export part of their production to neighboring countries. Sales of peanut leaves for animal consumption are another component of the unofficial market.

The official market only accepts unshelled peanuts during five months of the year, from December through April. Peanuts are sold to two companies, a public company for the production of peanut oil and a private company for the production of confectionery peanuts.

The public company, SONACOS (Société Nationale de Commercialisation des Oléagineux du Sénégal)³, buys raw peanuts through contract agreements with farmers. Part of SONACOS purchases is stored, treated with chemicals and sold to farmers as high quality seeds through Sonagraines, which is owned by SONACOS or sold to private seed suppliers when the growing season approaches. The rest of the purchases is processed into peanut oil and cakes for animal feed in mills owned by SONACOS. From each ton⁴

² The terminology official/unofficial is no longer valid since the passage of a bill on July 8, 1988, which legalized the unofficial market. However, the existence of this law is not widely known (Gaye, 1998 b). The terms official/formal and unofficial/informal are used interchangeably.

³ SONACOS has a monopoly on the purchase of peanuts and on the sale of peanut oil. It is afforded a high level of protection on vegetable oil imports while its imports of unrefined vegetable oil are duty free. This public company is being privatized.

⁴ Here and in the rest of the thesis the unit used is the metric ton.

of unshelled peanuts, SONACOS produces 350 kilograms of oil and 350 kilograms of cakes (Gaye, 2001).

The private company NOVASEN (Nouvelles Arachides du Sénégal)⁵, also buys raw peanuts through contract agreements with farmers. One part of these purchases is returned to the contracted farmers in the form of high quality seeds. The other part is processed to produce edible peanuts (confectionery, paste and butter) and cakes. The by-products are sold to SONACOS to be processed into oil.

Peanut oil and cakes are sold to consumers in Senegal, 46 percent and 59 percent of their production respectively. The rest is mainly exported to Europe (FAO, 1999). Figure 1.2 presents the different actors in the Senegalese peanut sector.

⁵ The private company NOVASEN is the only institution in West Africa, which vertically integrates all the activities in the peanut sector: crop production, harvest, processing and exports of confectionery peanuts.

An important pre and post-harvest problem is the contamination of peanuts with aflatoxins. Aflatoxins are highly toxic substances produced by fungi Aspergillus flavus and Aspergillus parasiticus. The aflatoxin problem has two major implications: 1) aflatoxins are very harmful to human and animal health causing fatal liver damage; 2) peanut exports to Europe are subject to strict quality standards. This problem is particularly associated with confectionery peanuts and peanut cakes because toxins are eliminated during the transformation of peanuts into oil. The aflatoxin contamination is affected by air temperature and humidity levels. Contamination is more likely to occur when temperature is within the range 25-32°C and relative humidity is greater than 84%. Contamination risks are increased when peanuts are damaged by drought (before harvest), pest attacks (before or after harvest) or harvested before maturation. According to scientists, an effective solution to this problem requires integrated measures before, during and after harvest. The development of resistant varieties to aflatoxin contamination is a hard task given that contamination may occur at any stage of the peanut production and marketing process. However, some varieties such as 55-437 (the most resistant variety in Senegal and one of the four most resistant varieties in the world), 73-30 and 73-33 exhibit a good resistance level (Ba et al, 1999).

1.3 History of the peanut sector and related governmental policies in Senegal

As discussed below, though the Senegalese peanut sector developed and became one of the most important peanut producers in Africa during the first half of the past century, imperfections in the agricultural institutional system, drought, political events in Europe and Africa and world economic shocks affected it considerably. Peanut

production and exports grew rapidly in French West Africa as France attempted to make its colonies support themselves. As shown in table 1.2, between 1875 and 1958, exports were increased by 58 times and grew with an average annual growth rate of 68 percent.

Table 1.2: Early Growth of Peanut Exports from Senegal

YEARS	TONS
1875	13.9
1885	45.1
1895	51.6
1905	96.2
1915	303.1
1925	453.7
1936	487.3
1948	451.0
1958	808.0

Source: Cruise and Donal, 1975.

During the colonial period, two major goals motivated the intervention of the French administration in the peanut sector: (1) ensuring adequate revenues and (2) rewarding political allies. This second objective caused the French administration to control the peanut sector according to political instead of economic interests.

After independence, because the peanut sector represented an economically and politically crucial sector of the economy, the Senegalese government attempted to increase peanut production. A major agricultural program was implemented to provide research, extension, credit, inputs, equipment, marketing and processing. In the first two decades after independence, fertilizer subsidies averaged 56 percent. The government set the price of peanuts and peanut marketing to private traders was prohibited. This government support contributed to the development of the peanut sector. However, the government's large expenditure generated a deficit in the balance of payments and a shortage in foreign exchange for the payment of the external debt (Lopez and Hathie,

1998). Furthermore, after the creation of the European Economic Community, France was pressured to end its preferential trade in favor of Senegalese peanut products, generating a significant decrease in Senegalese peanut exports and in farmers' revenues (Ba, 1998). In order to adapt the peanut sector to changes in the terms of trade, the government restructured the production, processing and marketing of peanuts through the creation of vertically-integrated parastatal organizations. However, because these organizations responded more to political pressures than to economic logic, they became exploitative and subject to abuses of power (Gray, forthcoming; Diagana and Kelly, 1996). The political intervention of the authorities in the peanut sector since the French occupation, and the oligopolistic nature of the peanut market, progressively generated structural problems. "The cumulative effects of over-centralization, inefficiency and corruption in the input distribution and marketing parastatal ONCAD [Office National de Coopération et d'Assistance pour le Développement] and the agricultural extension parastatal SODEVA [Société de Développement et de Vulgarisation Agricole] were having a noticeable impact on the economic performance of the agricultural sector (Crawford et al, 1996, p. 18)." Moreover, "producer prices for peanuts and cotton were systematically kept lower than the level required by true marketing margins. The net result of the pattern of intervention on both the input and output sides was positive to the state and agro-industrialists both, as well as the larger farmers... (Delgado and Jammeh 1991, p.7)."

Furthermore, peanut production has been affected by its dependence on rainfall as opposed to irrigation and successive years of increasing drought in the Sahel. As shown

in table 1.3, both the average annual peanut production and the average annual rainfall decreased every decade by 11 percent and 8 percent respectively between 1960 and 1999.

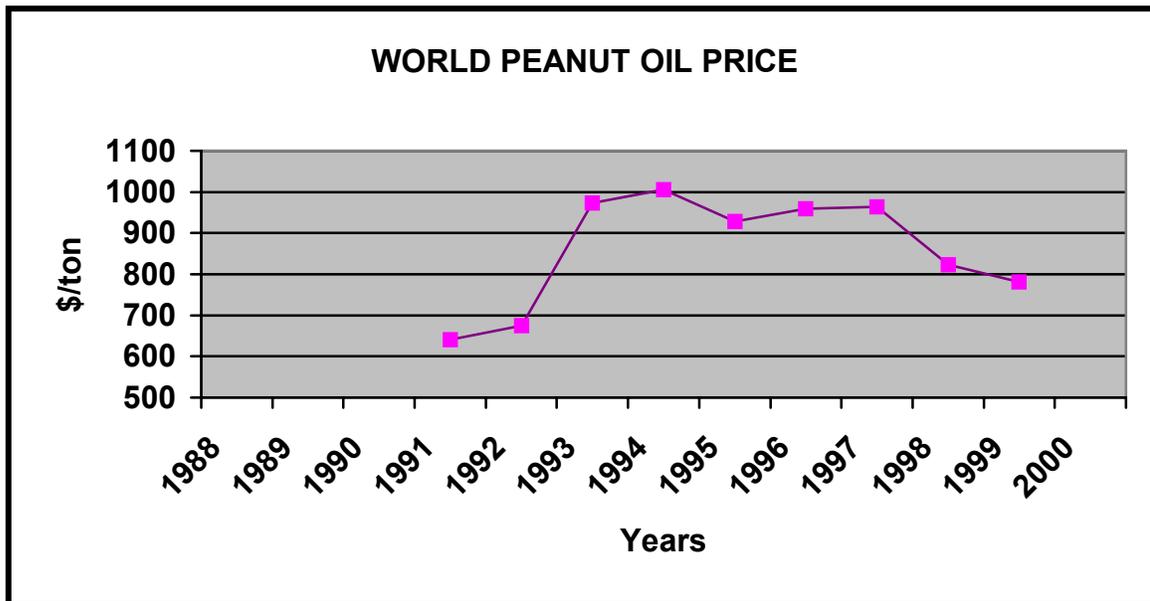
Table 1.3: History of Peanut Production in Senegal

	AVERAGE PRODUCTION (1000 TONS)	AVERAGE RAIN FOR THE ENTIRE COUNTRY (MM/YEAR)
1960-69	932	762
1970-79	875	640
1980-89	778	587
1990-99	633	571*

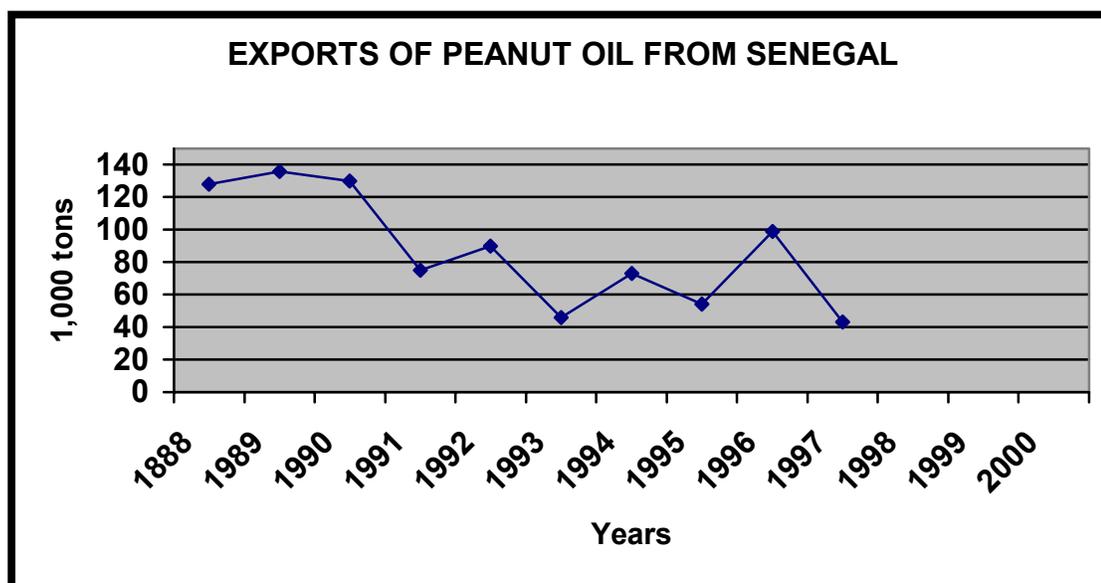
* Peanut basin

Source: Crawford et al (1996) and IMF (2000).

In addition, declining world prices adversely impacted the Senegalese economy. Senegalese peanut oil exports suffered from the increasingly competitive world market and the sustained decrease in world peanut oil prices. As shown in figure 1.3, between 1988 and 1997, oil exports fell with an average annual rate of 7 percent and oil world prices (Rotterdam cost insurance fret) tended to decrease between 1994 and 2000.



Source: World Oil Annual, 2000.



Source: FAO, 1999.

Figure 1.3: World peanut oil prices and exports of peanut oil from Senegal

Several other international economic shocks were a great blow to the Senegalese economy (Delgado and Jammeh 1991). In the second half of the 1970's, the price of phosphate, which is another important export product in Senegal, fell. Conversely, the price of petroleum, an import of Senegal, increased when petroleum crises occurred in the 1970's and 1980's. Also, the interest rates and exchange rates for the most important currencies (US Dollar and French Francs) rose and contributed to the problems facing the Senegalese economy. The peanut sector's contribution to Senegalese trade diminished as peanut production and exports decreased. Gross Domestic Product decreased aggravating foreign debt. The payment of foreign debt rose from 4 percent of the value of the exports in 1972 to 15 percent in 1978-79 (Gray, forthcoming). At the microeconomic level, farmers' revenues decreased (see previous section) and their debts increased (Crawford et al, 1996). In this context, the Senegalese Government "approached the multilateral financial institutions in 1979 for assistance with an invitation to policy dialogue, contrary to the image that Structural Adjustment was always initiated from Washington (Delgado and Jammeh 1991, p.9)".

The purpose of the structural adjustment was to stabilize the economy by reducing government spending, promoting economic growth and reducing trade deficits and foreign debt. Another objective was to provide a framework for the movement of financial aid to Senegal and the implementation of targeted IMF and World Bank programs in the 1980's. The reform of agricultural policies was one of the major components of the Structural Adjustment Loan provided by the World Bank. The specific objectives of this part of the program were to liberalize input supply and establish a basis for agricultural development, decentralize the rural credit system and the costly and

inefficient rural development agencies (Gellar, 1982), liberalize trade, and so forth. Another component of the new policies was to encourage the production of food crops (millet, rice, maize, sorghum) and to discourage the production of cash crops (peanuts) via a new food crop pricing and input supply policies in order to improve food self sufficiency.

The impact of structural adjustment on the agricultural sector in Senegal was ambiguous. Some progress in decentralization has been observed, but the program failed to improve input distribution. The pricing decisions were depoliticized. The input market liberalization was followed by an increase in input price. Producers reduced or ended their purchased input use. Consequently, productivity decreased. The output decrease and reduced subsidies caused producers' welfare to decrease. Lopez and Hathie (1998) estimate that before the implementation of structural adjustment, the cost of the subsidies to taxpayers was lower than the benefits from input subsidies to producers. They suggest compensating for the rise in input price by raising productivity through research and extension and by implementing targeted relief programs for producers who are considered the permanent losers of the adjustment programs. Also, the output decrease combined with the development of the unofficial market caused a gap between government peanut purchases (250,000 tons in 1995) and the mills' processing capacity (900,000 tons) (Ba, 1998). Because peanut production is less and less competitive, it is less attractive to producers who are moving towards other crops such as watermelon.

In conclusion, the structural adjustment programs didn't solve the problems of the peanut sector. The reduction of input use, the reduction of soil quality and aging equipment affected peanut productivity. Ba (1998) suggests the lack of institutions to

replace the government's intervention after it was suppressed as an explanation for the failure of the structural adjustment programs.

In January 1994, the devaluation of the CFA Franc by 50 percent had another major impact on the peanut sector. Because devaluation increased output prices (40 to 70 percent) more than it increased input prices (20 to 50 percent), it enhanced the profitability of the major crops (millet and peanut) (Diagana and Kelly, 1996). However, inflation reduced the positive effect of devaluation on farmers' incomes (Akobundu, 1998). The relative prices encouraged farmers to increase the share of peanuts in their crop mix by 30 percent in the first planting season after devaluation (Diagana and Kelly, 1996). Because devaluation didn't change the fact that it was more profitable to plant high densities on unfertilized land than recommended densities on fertilized land, farmers didn't adopt soil enhancing technologies. As a consequence, soils were mined and seed quality was reduced. To reverse this trend, studies suggest providing an incentive for more fertilizer use in order to reduce crop density and soil degradation through the supply of more affordable fertilizers (Diagana and Kelly, 1996).

1.4 The peanut pricing policies

The peanut pricing policy remained unchanged under the structural adjustment program. Peanut price was still subsidized by the Caisse de Péréquation et de Stabilisation des Prix, whose funds were mostly provided by Stabex. The European Economic Communities (EEC) established the Stabex scheme in 1975 within the framework of the Lomé Convention between the EEC and the African, Caribbean and Pacific (ACP) countries. The objective of this scheme was to offset fluctuations in export

earnings, maintain the oil and confectionery peanut supply in Europe and stabilize the purchasing power and the imports of ACP countries from Europe.

After the implementation of the structural adjustment program, “a sharp drop in the export price for peanuts ... led to heavy losses for the Government’s commodity price equalization and stabilization agency (Delgado and Jammeh, 1991, p.48)”. Consequently, the government established a new pricing policy. Its objectives were on the one hand to stabilize peanut prices through ensuring a base price for producers and on the other to reduce the cost of subsidies and to introduce some flexibility in establishing prices relative to world market price fluctuations (Gaye, 1998 b).

This new mechanism of price determination was initiated with the signing of an outline agreement among the Senegalese government, SONACOS and CNIA (Comité National Interprofessionnel de l’Arachide) in 1996. Yearly negotiations are held in March and April with all the CNIA members in the peanut sector (farmers, millers, traders and public agencies). A unique base producer price is fixed within the range of the highest and the lowest levels of the peanut oil and cake world prices and on the basis of production costs in recent years. The price determination is based on world prices in the past five years (35 percent) and in the months since the beginning of the current year (65 percent). The cost of the subsidy is born by the government who essentially collects its funds within the Stabex scheme and from taxes on oil imports. Table 1.4 describes the monetary transfers that occurred since the implementation of this new pricing policy.

Table 1.4: Assessment of the implementation of the current pricing policy

	1996-97	1997-98	1998-99	1999-00
Consumer price (CFA Francs/kg)	183	137.656	114	142
Producer base price (CFA Francs/kg)	131	150	160	145
Difference (CFA Francs/kg)	+ 52	-12.344	- 46	- 3
Quantities (tons)	96,000	154,962	242,142	450,000
Cost of subsidy (million CFA Francs)	0	2,128	11,500	1,350

Source: Senegal, Republic of, Ministère de l'Economie, des Finances et du Plan, 2000 (a).

Peanut oil and cake markets were liberalized in 1995, but barriers on imports of non-refined and refined oil (soybean oil, palm oil) still protect the production of peanut oil. This trade policy was implemented in 1991 and updated in 1998. The trade barriers consist of a levy (variable per unit taxes for different ranges of the import price, CAF Dakar) (Senegal, Republic of, Ministère de l'Economie, des Finances et du Plan, 2000 b).

1.5 Agricultural research in Senegal

Bravo-Ureta (1998) commented that growth and development of the peanut sector in Senegal requires increasing peanut production. Output growth is facilitated by two conditions: productivity enhancement and increased input use. There are two possible ways to increase productivity: a technological change and increasing technical efficiency. Technical efficiency is affected by education, training and experience. These three factors combined with agricultural research and development can lead to technological change.

Four broad objectives are attributed to agricultural research (Masters, 1996):

- improvement of overall living standards,
- enhancement of food security and economic stability,
- reduction of poverty,
- sustainability of natural resources.

Agricultural research on peanuts in Senegal is currently conducted by the Institut Sénégalais de Recherche Agricole (ISRA) in collaboration with the Centre International de Recherche Agronomique pour le développement (CIRAD), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the peanut CRSP⁶. The main goal of agricultural research in Senegal is the production of improved varieties adapted to the quality requirements (nutrition, health, tastes and so forth) and to the environmental conditions. Research is also conducted on fertilization, crop and seed protection and post-harvest technologies.

Given the economic importance of the peanut sector in Senegal, agricultural research has been conducted to release new peanut varieties in order to improve peanut productivity and achieve economic and social objectives, particularly in rural areas. ISRA and the peanut CRSP adapted several new peanut varieties to the agro-climatic conditions in Senegal. The last variety developed by ISRA and the Peanut CRSP is La Fleur 11. Research on La Fleur 11 started in 1985. The variety was tested from 1991 to 1993. After the variety was proposed for release in 1992, it was approved in 1993. The variety was then multiplied on selected farms between 1993 and 1996 to spread La Fleur 11 use and to observe how the variety behaved outside experimental conditions. It was broadly marketed in 1997. La Fleur 11 was bred for the central area where rainfall is between 300 and 500 mm a year. Its growth cycle is about 90 days.

La Fleur 11 has several interesting characteristics. It is an oil variety with a high oil content (50-51 percent of the dry seed). It produces shells early that can be sold for consumption in the informal market in order to provide cash to the farmers. Also, La Fleur 11 produces large leaves that are used for animal feed. The shells are bigger than

⁶ Appendix C presents the role and activities of the Peanut CRSP.

those of the variety 55-437 that La Fleur 11 is replacing, and its yield has been estimated to be 30 percent higher than that of 55-437 under experimental conditions. Given these characteristics, plantings of La Fleur 11 quickly spread from the central region to the south and to the north where the variety adapts very well to irrigated conditions.

1.6 Problem statement

Surveys conducted in 1996 by the National School of Applied Economics in Senegal (ENEA) and the University of Connecticut reveal that La Fleur 11 has higher yields than the old variety 55-437. Table 1.5 provides a technical comparison between La Fleur 11 and 55-437. At the farm level, land planted with La Fleur 11 represents 23 percent of the land planted with 55-437. However, La Fleur 11's labor productivity and seed productivity exceed those of 55-437 by 25 percent and 12 percent respectively. La Fleur 11's yield exceeds 55-437's by 29.9 percent confirming ISRA's estimation of 30 percent.

Table 1.5: Technical comparison between La Fleur 11 and 55-437

Peanut varieties	Areas Ha/farm	Ratio output/workers-day	Ratio Output/seeds	Yields Kg/ha
La Fleur 11	0.76	14.73	7.33	515.07
55-437	3.3	11.74	6.52	396.26

Source: Surveys in Bravo-Ureta, Hathie and Thiam (1998) and Sow (1998).

An economic comparison shows that variable costs are greater for La Fleur 11 than for 55-437 on average. Farmers use 17% more seeds of La Fleur 11 than of 55-437. The unit-price of La Fleur 11 seeds is higher (465 FCFA/kg on average) than that of 55-437 (224.5 FCFA/kg on average). The unit-price of La Fleur 11 output is higher (250-300 FCFA/kg) than that of 55-437 (250 FCFA/kg on average) (Sow, 1998). According to Bravo-Ureta et al (1998), although the variable costs of La Fleur 11 are higher, its gross returns and profits are greater than those of the variety 55-437 are.

However, La Fleur 11 has some disadvantages. It is a non-dormant variety. Therefore, it germinates in wet conditions, which poses storage problems. Research is currently underway to develop a dormant variety (Ndoye, July 19th 2000). It is subject to leaf diseases such as cercosporiosis and rust and to attacks by Aspergillus flavus. These problems are particularly important when this variety is grown outside the region it was developed for, the center of the peanut basin (Ba et al, 1999).

Moreover, some problems have been reported about the use of La Fleur 11. Farmers do not follow the technical recommendations for La Fleur 11 regarding seed density, irrigation, fertilization, crop cycle duration and so on. Shells are vulnerable to pests and peanuts are harvested before maturation for direct consumption, which exposes La Fleur 11 to contamination by aflatoxins. The genetics of the variety are unstable. The variety behaves as a hybrid, which meant that further research on La Fleur 11 to stabilize its genetics was necessary before its release. All these problems have had a major effect on La Fleur 11 by decreasing its yield comparative advantage and affecting its adoption by farmers (Boye, 2000). Other obstacles to adoption are the production of an adequate seed supply (Peanut CRSP web page, 1999) and the shortage of operating capital to purchase the seeds (Bravo-Ureta, Hathie and Thiam, 1998).

In conclusion, though La Fleur 11 meets the expected yield increase in comparison to 55-437, some problems need to be addressed in order to take full advantage of the potential offered by La Fleur 11: increasing the seed supply, improving the dissemination of La Fleur 11, providing credit and technical assistance and informing farmers about the appropriate practices (Bravo-Ureta et al, 1997 and 1998).

1.7 Objectives

The main objective of the study is to develop an impact assessment evaluation procedure for the peanut sector in Senegal. It will be tested on La Fleur 11 but can be replicated for other interventions.

The sub-objectives of the study are as follows:

- performing an ex-ante evaluation of the adoption of La Fleur 11 in order to evaluate the magnitude of the returns from the intervention of the Senegalese government in the development of this new variety;
- disaggregating the Senegalese peanut sector vertically and computing the benefits from research on La Fleur 11 for the main commodities of the sector: farm household consumption, farm sales of unshelled peanuts on the unofficial market, farm sales of seeds on the official market and SONACOS sales of peanut oil and cakes;
- for each commodity and each market, determining the distribution of the benefits among consumers, producers and the government;
- evaluating the effect of a subsidy on the benefits from research when the producer base price applies to farm sales of unshelled peanuts on the official market.

1.8 Summary of methods

The analysis is based on the assessment of the research-induced change in economic surplus in a partial equilibrium framework. The economic surplus analysis consists of the evaluation of the change in economic surpluses when a new technology is adopted. In order to take into account the change in supply and evaluate the benefits

throughout the life of the new technology, discounting is employed in the analysis (see chapter 2).

1.9 Structure of the remainder of the thesis

The study contains three more chapters. The second chapter is a detailed presentation of the conceptual framework. The third chapter is an exposition of the data used for the impact assessment and the results of the surplus analysis. The fourth chapter contains a summary of the research, conclusions of the study, limitations of the study and suggestions for future research.