

**Acquisition and Use of Agricultural Inputs in the
Context of Senegal's New Agricultural Policy:
The Implications of Farmers' Attitudes and
Input Purchasing Behavior for the Design of
Agricultural Policy and Research Programs**

by

Valerie Auserehl Kelly

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SPECIAL NOTE FOR ISRA-MSU REPRINTS

In 1982 the faculty and staff of the Department of Agricultural Economics at Michigan State University (MSU) began the first phase of a planned 10 to 15 year project to collaborate with the Senegal Agricultural Research Institute (ISRA, Institut S n galais de Recherches Agricoles) in the reorganization and reorientation of its research programs. The Senegal Agricultural Research and Planning Project (Contract 685-0223-C-00-1064-00), has been financed by the U.S. Agency for International Development, Dakar, Senegal.

As part of this project MSU managed the Master's degree programs for 21 ISRA scientists at 10 U.S. universities in 10 different fields, including agricultural economics, agricultural engineering, soil science, animal science, rural sociology, biometrics and computer science. Ten MSU researchers, on long-term assignment with ISRA's Department of Production Systems Research (PSR, D partement de Recherches sur les Syst mes de Production et le Transfert de Technologies en Milieu Rural) or with the Macro-Economic Analysis Bureau (BAME, Bureau d'Analyses Macro-Economiques) have undertaken research in collaboration with ISRA scientists on the distribution of agricultural inputs, cereals marketing, food security, farm-level production strategies and agricultural research and extension. MSU faculty have also advised junior ISRA scientists on research in the areas of animal traction, livestock systems and farmer groups.

Additional MSU faculty members from the Department of Agricultural Economics, Sociology, Animal Science and the College of Veterinary Medicine have served as short-term consultants and professional advisors to several ISRA research programs.

The project has organized several short-term, in-country training programs in farming systems research, agronomic research at the farm-level and field-level livestock research. Special training and assistance has also been provided to expand the use of micro-computers in agricultural research, to improve English language skills, and to establish a documentation and publications program for PSR Department and BAME researchers.

Research publications from this collaborative project have been available only in French. Consequently, their distribution has been limited principally to West Africa.

In order to make relevant information available to a broader international audience, MSU and ISRA agreed in 1986 to publish selected reports as joint ISRA-MSU International Development Paper Reprints. These reports provide data and insights on critical issues in agricultural development which are common throughout Africa and the Third World. Most of the reprints in this series have been professionally edited for clarity; maps, figures and tables have been redrawn according to a standard format. All reprints are available in both French and English. A list of available reprints is provided at the end of this report. Readers interested in topics covered in the reports are encouraged to submit comments directly to the respective authors, or to Dr. R. James Bingen, Associate Director, Senegal Agricultural Research and Planning Project, Department of Agricultural Economics, Michigan State University, East Lansing, MI 48824-1039.

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ABSTRACT

This report brings together information from a number of previously published ISRA working papers on seed and fertilizer issues and presents for the first time some information on acquisition and use of agricultural equipment. The research was conducted between April 1984 and April 1986. The report is preliminary; a doctoral dissertation currently in progress will provide a more refined analysis and presentation of results.

A description of farmers' acquisition and use of agricultural inputs during 1981-85 is presented. Constraints related to a lack of purchasing power, farmers' attitudes, and distribution system inadequacies are examined and the implications of these constraints for agricultural policy, extension, and research programs are discussed. The informal private sector operating in weekly markets was found to respond better to farmers' input needs than the "officially sanctioned" private sector (SONACOS, UNCA, ICS, SISMAR) and better coordination between these two distinct levels of private sector operators is recommended. A number of suggestions are made for collection of micro-level data which are deemed essential to the development of input price policies and quantified estimates of effective demand for various types of inputs.

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INTRODUCTION

**Senegalese Agricultural Production and
Policy: The Current Situation**

Senegal is experiencing a worrisome trend of declining food and cash crop yields linked to drought, inadequate pest control, plant disease, declining soil fertility, and rising input prices. The consequences reverberate throughout the economy as the peanut oil industry becomes a budgetary liability rather than an asset and the food import bill rises dramatically.

Since 1980 Senegalese agricultural policy has been defined increasingly by foreign aid donors who maintain that (1) the private sector should perform many of the tasks traditionally carried out by government and (2) price distortions associated with various subsidies and taxes should be removed. In an attempt to withdraw from direct involvement in the agricultural sector the Senegalese government has implemented a number of very important changes in the way agricultural inputs are financed and distributed to farmers. The general tendency has been to do away with government-financed agricultural credit, eliminate subsidies on agricultural equipment and fertilizer, and discontinue distribution through government and parastatal agencies. Concurrently, the government has raised producer prices to compensate for the input price increases triggered by the first three actions and compounded by rising world market prices for raw materials used in the manufacture of inputs.

Many question the viability of these changes and the underlying principles which are incorporated in the Nouvelle Politique Agricole (NPA)a

recently elaborated by the government.¹ The critics believe that announced increases in agricultural product prices will not adequately compensate farmers for the loss of credit and subsidy programs. If this is true, farmers will lack the incentive to augment agricultural investment. Without this increased investment, the private sector will face insufficient demand to allow it to establish a viable alternative to government input distribution.

Research on Input Acquisition and Use

Information needed to refine NPA policies and develop private sector distribution systems is currently lacking. In response to this problem, the Bureau d'Analyses Macro-Economiques de l'Institut Sénégalais de Recherches Agricoles (BAME-ISRA) designed a research program in 1984 to collect information on various aspects of agricultural input acquisition and use. The first year was devoted to a descriptive and diagnostic study of the 1984/85 fertilizer distribution system in the Sine Saloum, Casamance, and Senegal River Basin.² In 1985/86 surveys on farmers' perceptions of their major constraints, preferences for different input distribution policies, past input acquisition and use, and anticipated responses to recent policy changes were conducted in the Departments of Gossas and Niore (Sine Saloum). In addition, detailed production data collected by the Société de Développement et de Vulgarisation Agricole (SODEVA) during the 1981-84 period have been used to describe recent trends in farmer input use and productivity.

A number of ISRA publications that provide detailed information (specific objectives, methodology, sampling procedures, and research findings) on the individual studies conducted under the overall research program are mentioned in the reference section of this report. This paper presents the salient findings of the separate studies in order to help policy makers concerned with the improvement of current input distribution systems. The conclusions and recommendations are of particular relevance

¹See Diouf (1985) for details on specific NPA changes implemented in 1985.

²See Crawford and Kelly (1984) and Crawford, et al. (1985).

for the Departments of Gossas and Nioro, but should be of general interest for the entire Sine Saloum.

Organization of the Report

The report begins with a brief discussion of the major constraint to increased agricultural investment at the present time--farmers' lack of purchasing power. The next three chapters present research findings on farmers' acquisition and use of seeds, equipment, and fertilizer during 1981-85. These chapters include a discussion of actual behavior as well as attitudes about different inputs, investments, and distribution policies. The fifth chapter describes a number of distribution system problems encountered in the first year of the NPA. The sixth chapter discusses the implications of research findings for future policy refinement and development of input distribution systems. The seventh chapter discusses the problem of developing input distribution and price policies given existing data and makes recommendations for research programs that could contribute substantially to the policy process.

THE PURCHASING POWER CONSTRAINT

The greatest challenge to the NPA's success is that the government wants farmers to pay unsubsidized prices when they have no access to credit and their capacity to invest in agriculture has been seriously eroded by a succession of poor harvests. The empirical evidence overwhelmingly supports farmers' contentions that they currently lack the financial liquidity required to improve their agricultural productivity.

(1) Analysis of 1981-84 SODEVA data for 41 farmers in Gossas and Nioro shows that:

- a. Millet production was less than 200 kilos per person during 3 of the 4 years;
- b. Annual peanut revenues remaining after allowing for millet purchases to meet a 200 kilos/person minimum food requirement

averaged 17,000 FCFA per capita in Gossas and 20,500 FCFA in Nioro.³

(2) ISRA survey data reveal that during 1981-85 disinvestment, dissavings, and indebtedness were common. In order to provide food for their families,

13 percent of farmers sold peanut seed

24 percent sold one or more pieces of agricultural machinery

36 percent sold one or more traction animals

71 percent sold small ruminants

31 percent sold cattle

Although no official credit program existed, farmers continued to incur debts for food (approximately 40 percent of farmers) and seed (approximately 50 percent, primarily in 1985).⁴

(3) Despite relatively good 1985 rains, 66 percent of Gossas and 33 percent of Nioro farmers anticipate cereal shortfalls before their 1986 harvest. Insects and plant disease are responsible for most of the deficit, but lack of peanut revenues also forced some farmers to sell millet.

(4) Despite substantial increases in the producer price of peanuts, farmers claim 1985/86 peanut revenues were generally lower than previous years because they were unable to procure adequate supplies of seed.

Problems of poor productivity, disinvestment, and dissavings are encountered in all types and sizes of farms; they are not associated with only the small, resource-poor farms which have always led a precarious existence. These results suggest a gloomy future for rainfed agriculture in the Sine Saloum, unless rainfall improves substantially. Given present policies and conditions--no credit, no seeds, and no food aid--many of these

³This analysis is based on a very small sample and we cannot be sure that these revenues are representative of the entire Sine Saloum. Kelly and Gaye (1985) provides more information on the nature of the sample and additional indicators of agricultural production performance. Even if these net revenues were doubled, they would fall far short of amounts needed to assure minimum personal needs (food other than millet, clothing, etc.) and agricultural investment.

⁴See Kelly and Gaye (1985) for a more detailed discussion of disinvestment, dissavings, and indebtedness.

farmers, particularly those who have no source of revenue other than crop production, may never recover.

FARMERS' ATTITUDES AND PAST BEHAVIOR REGARDING ACQUISITION OF PEANUT SEED

Securing an adequate stock of peanut seed has been the major preoccupation for the majority of farmers in recent years. Since 1980, government seed distribution policy has frequently changed the criteria for determining who receives what quantity of seed; the most recent revision has been to discontinue government distribution entirely. These changes usually have been announced at the end of the dry season when it was too late for farmers to compensate for the less than anticipated official distribution. Furthermore, farmers complain that there has been a continual deterioration in the quality of seeds distributed. Ninety-three percent of farmers considered changes in seed distribution policy to be the most detrimental of all NPA initiatives. The strongest objection was to the discontinuance of the official distribution; small farmers and those who experience major crop losses due to drought, insects, disease, etc., cannot be expected to replenish their seed stock without some type of outside assistance. Farmers see no one but the government capable of giving this assistance. Thirty-one percent of farmers cited insufficient quantities of seed as the most important agricultural constraint during the 1981-85 period while an additional 63 percent ranked the seed problem second only to poor rains.

SODEVA data as well as ISRA survey results show that farmers do have a tradition of reserving seed after a good harvest; poor rains, however, have reduced amounts allocated to personal stocks since 1981.⁵ Farmers give priority to seed purchases, despite the inadequate stocks actually procured. When farmers were asked what they would have done just before the rains began in 1985 if they had had 15,000 FCFA cash, 52 percent gave seed purchases priority and 40 percent placed seed second only to food purchases. Poor cereal harvests and lack of cash have been the major constraints to

⁵See Gaye (1986) for a detailed discussion of seed storage behavior during the 1981-85 period.

increased seed acquisition. Forty-five percent of farmers believe that the government will eventually be forced to distribute seed again or risk jeopardizing the entire Senegalese economy. This belief causes some to postpone purchasing until the last minute in the hope that the government will reinstitute an official seed distribution, but it does not appear to be a major factor inhibiting purchases.

Information obtained on cash purchases which did take place in 1985 suggests that the informal market responded better to farmers' needs than the official market supervised by the Société Nationale de Commercialisation des Oléagineux du Sénégal (SONACOS). Seed placed on sale by SONACOS was available for a short period at a limited number of distribution points. Minimum quantities of 50 kilos had to be purchased and varieties available did not always conform to farmers' preferences.⁶ Furthermore, farmers considered the SONACOS price of 105 FCFA/kilo exorbitant, given that the producer price for the previous campaign was only 60 FCFA.⁷ The informal market permitted farmers to make numerous small purchases of preferred varieties during the course of the dry season at prices which were generally lower than 105 FCFA/kilo.

In 1985, seed credit was obtained by a limited number of farmers from relatives and other producers, with interest rates ranging from 0 to 100 percent. Not a single case of seed credit granted by local traders was reported.⁸ Seed credit offered by the Union Nationale des Coopératives Agricoles (UNCA) in collaboration with village cooperatives (sections villageoises), helped some farmers, but serious problems were encountered in administering the program and ensuring reimbursement. The village cooperatives were very lax at the time of allocating credit; most farmers claim they were not informed of amounts to be reimbursed and some even

⁶Despite government policy to distribute only a 90-day cycle peanut variety in Gossas, farmers prefer longer cycle peanuts which produce more hay.

⁷The gross price was 80 FCFA/kilo but a retenu of 20 FCFA/kilo was withheld to cover fertilizer and seed costs, leaving farmers with a net revenue of 60 FCFA/kilo.

⁸See Gaye (1986) for a discussion of factors which influence the availability of seed credit.

thought the seed was a gift. No contracts were signed between the UNCA and the village cooperatives nor between the village cooperatives and individual farmers. The overall rate of reimbursement for the Sine Saloum is about 85 percent, but getting to this level required costly and time-consuming intervention on the part of the government Service de l'Action Coopérative (SAC). There is also evidence that village cooperatives having reimbursed 100 percent of credit did so with the assistance of loans from local traders who expect to be reimbursed in peanut seed at a rate of 90 FCFA/kilo rather than the higher official rate (105 FCFA/kg).

Assuming the traders resell peanuts at about 105 FCFA/kg, they realize a 17 percent return on their 3-4 month investment (approximately 60 percent on an annual basis) while official interest rates for the 1985/6 campaign were 29 percent for 10 months (35 percent on an annual basis). Given the government's decision to reward village cooperatives that reimbursed 100 percent of 1985 credit by providing them with 1986/87 credit 1.58 times greater than 1985 amounts, most village cooperative/trader contracts will benefit both parties in the short run. Obviously, credit available to these cooperatives cannot be increased 150 percent annually so continued use of trader credit will eventually reduce amounts of seed available to farmers through official credit channels. Those cooperatives which borrowed from traders but did not reimburse 100 percent are already facing reduced allotments because they received less than their 1985 quota in 1986 as a penalty for incomplete reimbursement and they must also pay the traders' interest charges. The danger with this apparently symbolic relationship is that in the long-run the traders could become the primary recipients of seed which the government thinks is being made available to farmers on reasonable credit terms. Farmers wanting seed will have to deal with these traders and will undoubtedly pay a higher price than that demanded from officially sanctioned distributors.

As for future policy options, 78 percent of farmers prefer that the government reinstate seed distribution based on tax rolls (100 kilos per taxable male and 50 kilos per taxable female) with reimbursement in kind at marketing time, even if it requires increasing the interest rate to 40

percent. Only 8 percent preferred a continuation of the retenue system,⁹ while 14 percent would be happy with no distribution if the producer price of peanuts were raised to 120 FCFA/kilo.

If present policies continue, 13 percent of farmers (all in Nioro) prefer to purchase seed rather than store their own; this preference is linked to a desire to use peanut revenues for investments in non-agricultural activities during the dry season. On balance, farmers expressed a preference for purchasing unshelled seeds as they see no reason to pay others for work they can perform themselves. Twenty-five percent prefer to store their own seeds while 62 percent expressed interest in some type of community storage.¹⁰ Despite farmers' expressed interest in community storage, interviews with village cooperative officers revealed that no action had been taken at their level to encourage such activities. Only 13 percent of farmers expressed interest in the SONACOS seed bank, but they had certain reservations about the ability of SONACOS to assure timely delivery of good quality seed.

⁹The government introduced the retenue system for peanut seed with the 1981/82 campaign following large debt defaults which precipitated the dissolution of the agricultural credit program. Seed was distributed to farmers through official channels at the beginning of an agricultural season. At the end of the season the government withheld 10-15 FCFA/kilo (depending on the year) from the payment made to farmers marketing their peanuts in official channels. There was no direct correlation between quantities of peanut seed received and amount of retenue withheld. The system encouraged parallel market sales and never provided sufficient money to cover the costs of the seed distribution program. Beginning with the 1983/84 marketing period, an additional 5 FCFA/kg was withheld as a retenue for fertilizer. This retenue was to pay for fertilizer to be delivered the following season. Quantities received were to be proportional to the amount of retenue withheld. Crawford, et al. offers a detailed description and analysis of the retenue program for fertilizer.

¹⁰A recent USAID financed study found farmers much less interested in community storage than those in our sample: "La quasi totalité des paysans touchés ont gardé eux-mêmes leurs semences chez eux. Il répugnent presque à parler du regroupage; et certains disent qu'ils préfèrent avoir l'oeil sur leurs graines," Ly (1986).

FARMERS' ATTITUDES AND PAST BEHAVIOR REGARDING ACQUISITION OF AGRICULTURAL EQUIPMENT

Inadequate equipment (agricultural implements or traction animals) was never cited as the most important constraint during 1981-85, but it was mentioned as the second or third factor by 30 percent of farmers. Owing to forced sales and deaths, 55 percent of Gossas farmers have fewer traction animals now than they did in the early 1980s. In Nioro 25 percent have seen their traction animal inventory decline while 33 percent have managed to increase it. Fifteen percent of farmers have defective equipment requiring immediate replacement or costly repair and 9 percent believe that they will have to replace at least one machine within 5 years. Seventeen percent own one or more pieces of machinery which are non-functional but not considered a priority to repair or replace. When asked what they would have done with 15,000 FCFA extra cash just before the 1985 rains began, only one farmer gave equipment top priority; however, 26 percent mentioned it second and 23 percent third.

Equipment adequacy is often measured against norms for the number of hectares which can be effectively cultivated by a given configuration of equipment. Six hectares/seeder and four hectares/hoe are frequently cited norms which farmers using horse traction should not exceed if they want to adequately care for their fields; with oxen traction, capacity can increase to as many as 10 hectares depending on type of seeder and hoe.¹¹ Havard (1985) estimated that each seeder in the Sine Saloum was planting an average of 10-15 hectares while hoes were cultivating 7.5-12 hectares. In both cases, the estimated areas cultivated were far in excess of recommended norms, assuming that most farmers use horses. Our data show an average of 5.6 hectares per seeder and 4.4 hectares per hoe; these values are close to

¹¹See Kleene (1974) and Havard (1985) for various norms used to evaluate adequacy of equipment.

the norms cited above.¹² Although the averages are close to recommended norms, 38 percent of farmers exceed the recommended number of hectares for seeders, 50 percent for hoes, and 42 percent farm more than the recommended number of hectares per traction animal.

Late weeding is one of the most notable consequences of farming more area than recommended for a given equipment configuration. During 1981-84 only 13 percent of Gossas and 17 percent of Nioro millet fields were weeded within the recommended period; for peanuts the comparable figures are 36 and 25 percent.¹³

Fifty percent of farmers own no form of transportation, whether oxen, donkey or horse carts. Lack of transportation is a constraint to increased use of organic fertilizers and acquisition of bulky inputs such as chemical fertilizer and peanut seed, as well as timely peanut marketing.

Attitudes and preferences about equipment which influence farmers' investment behavior are:

1) Farmers are satisfied with equipment manufactured and repaired by local blacksmiths.

2) Farmers believe most equipment will last 'forever' if properly maintained; 26 percent do not envision ever having to replace their existing stock, 35 percent believe they will have no problems for at least 5-10 years.

¹²Havard's estimate was based on extrapolation from data on equipment sales during the agricultural credit program. Assuming a useful lifetime of 10-15 years for each implement sold, Havard estimated the current functioning inventory per region from the sales data. Information obtained in our survey makes it clear that most equipment has a useful lifetime greater than 15 years; this partially explains the difference between Havard's estimates of hectares farmed/implement and our survey results.

¹³Calculated with SODEVA data using weeding norms of 8 days after millet and 10 days after peanut planting.

3) Farmers have no concept of what current prices are for factory made equipment; their recent experience is based on purchases of used or locally made products which are significantly less expensive.¹⁴

4) Senegalese farmers (at least in the Sine Saloum) no longer need to be convinced that animal-drawn cultivation is better than manual. No one--not even those without equipment or animals--farms manually.

A variety of factors influence decisions to purchase equipment but there is little evidence that farmers analyze the investment in terms of potential profitability. Since the household head usually purchases equipment which is used on the personal fields of family members and contract laborers, it is difficult to do such analyses. Forty-three percent of farmers made at least one equipment purchase during 1981-85. Among the reasons most frequently cited for these purchases were: replacement of a defective machine or one previously sold to meet cash needs, had money to invest, increase in labor force, unhappy with existing model, had underutilized traction animal, tired of renting. Reasons for purchases of traction animals were: "trade-down" (sale of better quality animal to get cash for food, seed, and purchase of a cheaper animal); replacement of animal lost through death, sale, or withdrawal of loan; need for more animals; had money to invest; existing animals weak. Thirty-eight percent of purchases were financed entirely and 18 percent partially with peanut revenues.¹⁵ Thirty-two percent of transactions took place right after peanut marketing. Fifty-five percent of decisions to disinvest were

¹⁴As shown below, equipment prices actually paid by farmers during 1981-85 were significantly less than SISMAR's current prices for factory made implements:

	Actual Prices Paid, 1981-85			SISMAR Prices
	Average	Minimum	Maximum	
			(FCFA)	
Seeder	8,600	2,000	18,500	72,000
<u>Sine</u> hoe	9,250	5,000	16,000	37,000
Arara	6,400	3,000	12,500	49,200
Horse cart	39,500	25,000	60,000	105,800

¹⁵There was an important difference between Gossas and Nioro concerning sources of equipment financing. Only six percent of Nioro but 25 percent of Gossas purchases were financed partially by animal sales.

motivated by food needs and 11 percent by other needs for cash (marriage, illness, etc.).

Sixty-three percent of farmers expressed a preference for a new credit program permitting purchase of factory made equipment, while 32 percent would prefer an increase in producer price of peanuts instead of credit. Eighty-six percent of Gossas and 57 percent of Niore farmers claimed they would use equipment credit if it became available again. Sine hoes, seeders, and carts were the most frequently cited equipment for credit purchases. Most farmers thought they could afford reimbursement rates ranging from 5,000 to 15,000 FCFA per year. When offered a precise example of what a factory made seeder would cost in a new credit program, however, only 28 percent were interested in credit; the remaining 72 percent would rather purchase less expensive, locally made equipment for cash. Prices of factory made equipment pose a serious constraint to the reestablishment of an equipment credit program as long as locally made and used equipment are viewed as adequate, low cost substitutes by farmers.

FARMERS' ATTITUDES AND BEHAVIOR CONCERNING FERTILIZER PURCHASES

When farmers were asked to rank the three factors which had most seriously reduced their productivity during the period 1980-85, no one considered a lack of fertilizer to be the most important constraint. Ten percent ranked it second in importance and 17 percent third. Furthermore, only 19 percent mentioned fertilizer among their first 3 investment priorities if they had had 15,000 FCFA extra cash just before the 1985 rains began.

Despite the low priority given to fertilizer, half the farmers interviewed claimed to have purchased it at least once during the last five years; in any given year approximately 30 percent of farmers made purchases. The conventional wisdom in Senegal holds that inputs must be available at the time of peanut marketing, when farmers have the most money, in order to encourage investment in agriculture. Characteristics of reported fertilizer purchases suggest that this does not apply to fertilizer. Of 52 fertilizer transactions reported, only one took place at peanut marketing time.

Fifty-three percent of purchases were made at the beginning of the rainy season and 22 percent after crops had been planted.

Many producers buy fertilizer with earnings from animal sales or off-farm activities. These activities make money available at the end of the dry season, which partially explains why purchases are delayed. In addition, those who do have alternative activities (particularly petty commerce) are unwilling to tie up resources in fertilizer instead of working with it throughout the dry season.

Since farmers believe that fertilizer is "like salt in the sauce," (i.e., a nice touch but not essential), purchases are unlikely to take place until more important investments and consumption needs (food, minimum seeds and equipment, social obligations, etc.) are ensured. Finally, to reduce risk, some farmers will not purchase fertilizer until the rains are well established and good plant emergence has occurred.

Three factors distinguish fertilizer purchasers from non-purchasers:

- 1) Purchasing behavior during the fertilizer credit program
- 2) Attitudes about fertilizer and alternative investments
- 3) Access to non-crop revenues

Preliminary findings suggest that:

- 1) Farmers who had made some cash purchases during the credit program were more likely to have purchased in recent years.
- 2) Farmers whose combined cash and credit purchases during the credit program averaged more than 5 sacks per year were more likely to have bought recently.
- 3) Farmers who had non-crop revenues were more likely to have purchased than those who relied solely on crop revenues.
- 4) Farmers who did not buy were more likely to believe that an investment in 30 kilos of seed would increase yield more than an investment in 2 sacks of fertilizer.
- 5) Farmers who claim they apply fertilizer early (before the first weeding) were more likely to have purchased.

It has been suggested that Senegalese farmers' demand for fertilizer is constrained because they apply inappropriate amounts at incorrect times, on the worst soil, and thereby obtain mediocre results. These results lead them to discount the value of fertilizer and to invest their limited

resources elsewhere. Fifty percent of farmers were unable to quantify the average yield increase due to fertilizer, yet all believed that it had a positive effect when rains were good. Those farmers who could quantify yield response tended to expect higher yields than those indicated by results from many agronomic experiments, extension demonstrations, and farm-level surveys.¹⁶ Although a failure to appreciate the yield increasing potential of fertilizer does not appear to inhibit investment; labor and equipment constraints, as well as personal beliefs about agronomic relationships and risk avoidance strategies cause farmers to apply fertilizer later than recommended and are probably responsible for less than optimal fertilizer response.

When making decisions about fertilizer investments farmers do not attempt to estimate the probable economic returns because many are unable to quantify fertilizer response and those who can frequently lack the mathematical skills required to calculate returns. Evidence that fertilizer use is not dependent on a strict analysis of economic returns is provided in figure 1 which shows a shift from peanut to cereal fertilization. Given that farmers perceive the fertilizer yield response on peanuts to be equal to or greater than that on millet, and given that the peanut price per kilo is greater than millet, one would expect the profit maximizing farmer to favor peanuts in allocating his limited quantity of fertilizer. Farmers offer several explanations for favoring cereal fertilization: (1) increase in area planted in maize,¹⁷ (2) the relative ease of applying small quantities of fertilizer on millet rather than peanuts, (3) the need to assure cereal crop production given the small difference between peanut and

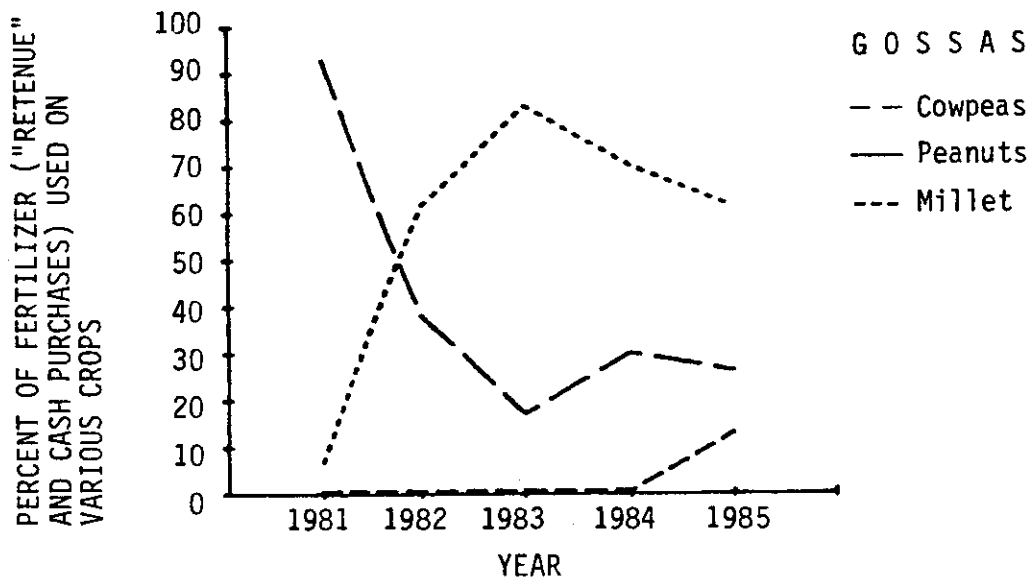
¹⁶See Kelly (1986) for a detailed comparison of farmers' perceptions of fertilizer yield response and research results.

¹⁷Maize areas have increased because of a concerted effort by SODEVA to expand maize production and because farmers are seeking an alternative cash crop to compensate for peanut seed shortages. Local maize has frequently been grown on small but fertile fields surrounding housing compounds. The expansion of maize production has required planting on former peanut and millet fields where farmers know the use of fertilizer is imperative if the maize is to succeed.

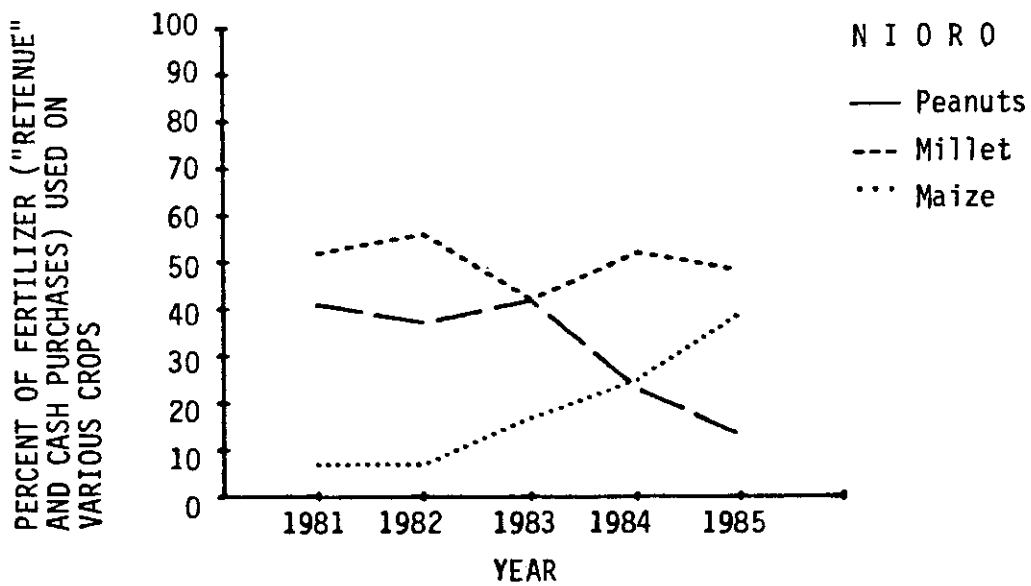
Figure 1

Changing Trends in Fertilizer Use
1981-1985

Only cash purchase and "retenu" fertilizer considered as farmers theoretically must apply contract fertilizer to specified crop.



Source: 1985/86 survey data for 22 farmers.



Source: 1985/6 survey data for 24 farmers.

millet prices, and (4) the importance given to the percentage fertilizer response in millet rather than the absolute response.¹⁸

When making purchasing decisions, some farmers resort to rules of thumb such as the peanut/fertilizer price ratio or personal concepts of maximum acceptable fertilizer prices.¹⁹ The most common practice, however, is to buy fertilizer if cash is left after all more important expenditures are made; this is based on a belief that fertilizer is a good and worthwhile purchase. Note that thirty-eight percent of farmers are unwilling to sell animals in order to purchase fertilizer. Even those willing to transform animal investments into fertilizer will not do so until the end of the dry season after food and seed is assured and fodder becomes scarce making animals more expensive to maintain.

The key to understanding fertilizer demand in this context lies in identifying those investments and expenditures that farmers place ahead of fertilizer. Figure 2 is a hierarchical decision model illustrating how fertilizer investments fit into farmers' investment/expenditure strategies for the 1985/6 season. As shown, most farmers did not pass the first two hurdles (food and seed) which stand in the way of fertilizer investment. What this model does not reveal is that once food, seed and other similar constraints have been overcome, many farmers will still not invest in fertilizer because they consider banabana (petty commerce) or animal investments to be more profitable and less risky than fertilizer.

¹⁸Using farmers' perceptions of yields with and without fertilizer application, we found the following median values for absolute and relative yield increases:

	Gossas	Nioro
<u>Peanuts</u>		
Absolute	300 kilo/ha	400 kilo/ha
Relative	31% increase	46% increase
<u>Millet</u>		
Absolute	300 kilo/ha	600 kilo/ha
Relative	75% increase	67% increase

¹⁹The most commonly cited "acceptable" peanut/fertilizer price ratio was in the 2 to 2.5 range. The most commonly cited maximum acceptable price for a 50 kilo sack of fertilizer was in the 2,000 to 2,500 FCFA range.

Given existing data it is difficult to quantify and compare returns to fertilizer and alternative investments, but farmers' perceptions and priorities are fairly clear.²⁰ If current policies and climatic conditions continue (high cost of fertilizer, shortage of peanut seeds, poor millet harvests, uncertain rains, absence of credit), fertilizer consumption is not likely to increase.

RECENT EVOLUTION OF THE INPUT DISTRIBUTION SYSTEM

A lack of purchasing power is the primary constraint on increased investment in agricultural inputs at the present time. There are a number of other important constraints associated with the distribution system, however, that could be overlooked because they appear inconsequential when compared to the cash constraint.

Past agricultural input distribution in Senegal has been compromised by the fact that both the distributor and the purchaser have consistently failed to honor contracts. Government has repeatedly delivered inputs late and changed the rules of the game in mid-stream. Farmers have repeatedly failed to pay their debts and many circumvent official marketing channels.²¹ Government officials mistrust farmers for selling in parallel markets, lying about harvests and resources available in order to get more handouts, selling inputs received on contracts and then claiming crop failure, etc. On the other hand, farmers are convinced that the government never gives them a fair price for their products and overcharges for inputs.²²

Many believe that a distribution sector run by private enterprise will be able to reduce distribution costs, respond to farmers' needs, and assure

²⁰See, for example, Faye and Landais (1984) or Demus and Tchakerian (1977) for some economic analysis of livestock investments.

²¹See Crawford, et al. (1985), Waterbury (1983), or the "Bilan annuel" published each year by SODEVA for further description and discussion of past government systems.

²²A good example of why farmers perceive inputs as overpriced is the fact that Senegalese retenu fertilizer was more than 5,000 FCFA per sack in 1985 while Gambian fertilizer, which is manufactured in Dakar, was only 1,000 FCFA.

reimbursement of debts to a greater extent than government systems did. Experience to date shows that "private sector" actors are reluctant to assume input distribution responsibilities. Those who have entered the input distribution network to date (SONACOS, UNCA, and village cooperatives) continue to face the same problems as their predecessors; part of the problem is that the new actors are not, strictly speaking, "private sector" and continue to carry many of the stigma associated with government agencies.

SONACOS, a mixed private-public enterprise, depends on the cash-short Banque Nationale pour le Développement du Sénégal (BNDS) to prefinance its activities. Toward the end of the 1985/86 marketing campaign SONACOS was unable to maintain the necessary liquidity to pay farmers promptly. Given the government's insistence that it will no longer absorb SONACOS's cost overruns, even more severe cash flow problems can be expected in the future. Furthermore, farmers do not make any distinction between SONACOS and its predecessors--they are all seen as arms of the government and therefore suspect. Farmers' lack of confidence in SONACOS has kept many from participating in the seed bank.

The UNCA is considered a farmer organization by the government yet it relied heavily on the Service de l'Action Coopérative (SAC) to distribute fertilizer and collect seed debts in 1985/86. Furthermore, there seems to be little sense of ownership experienced by most farmers attached to cooperatives; this explains in part the slow pace of credit reimbursement. The government considers village cooperatives to be farmer organizations yet they were created by administrative decree and often group together villages and ethnic groups which do not want to associate.²³ Experience with fertilizer distribution in 1984/85 and seed credit in 1985/86 suggest that these organizations lack both the sense of solidarity expected of farmer organizations and the requisite management skills needed for administering distribution programs.²⁴

The ability of these private sector actors to place inputs in locations whose accessibility would encourage farmers to increase purchases

²³See Sarr (1985).

²⁴See Crawford, et al. (1985) and Gaye (1986).

must be questioned. Data presented in the third chapter showed that the informal private sector responded to farmers' needs for peanut seed better in 1985/6 than SONACOS did. The discussion in the fifth chapter showed that fertilizer purchasers tend to make investments at the beginning of the rainy season when they visit weekly markets--this is not where the private sector is now making fertilizer available.

The "private sector" which has evolved to date continues to exhibit many of the weaknesses associated with its government predecessors: inadequate financing, poor rapport with farmers, inability to market inputs when and where farmers are most likely to buy. This is not surprising after only one year of experience, but a major effort will have to be made by both government and the private sector if the NPA is to increase the use of modern inputs.

IMPLICATIONS OF RESEARCH FINDINGS FOR AGRICULTURAL POLICY AND THE DESIGN OF DISTRIBUTION SYSTEMS

Alleviating the Purchasing Power Constraint

The private sector cannot develop a viable agricultural input distribution system if there is little effective demand for such products. The first step for policy makers is to encourage policies which will improve farmers' ability to mobilize cash for input purchases. This section examines policies most commonly used to improve farmers' investment capacity.

Product Prices

Producer prices were raised significantly this year (60 to 90 FCFA/kilo for peanuts and 50 to 70 FCFA/kilo for millet), but farmers' incomes remained low given the shortage of peanut seed and government's failure to intervene at the early period of cereal marketing when prices fell below the floor price.²⁵ Farmers who used maize and millet as cash crops this year

²⁵See Ndoye and Faye (1985) for a discussion of millet marketing.

adamantly state that these crops are less profitable than peanuts. This suggests that as farmers renew their peanut seed stocks, cereal production will decline. This could seriously compromise government food security objectives. A first step in addressing the problem is to assure that producer prices do not fall below the floor price at the beginning of the marketing period. This requires timely financing and intervention by government and officially sanctioned marketing services (SONACOS, UNCA, Commissariat à la Sécurité Alimentaire, SODEVA). A second step is to collect the necessary input/output data to evaluate farmers' claims. Is cereal production really less profitable? Why? Are there ways of increasing profitability without raising producer prices? Can the technology or farmers' application of existing technology be improved? Problems of millet production discussed in the second chapter suggest that price policy alone cannot resolve the low levels of millet productivity in many zones.

Input Prices

There is no question that farmgate input prices have increased much more rapidly than producer prices during the last ten years. Fertilizer jumped from 25 to 105 FCFA/kilo between 1976 and 1985, more than a fourfold increase; during the same period peanut prices increased only 2.17 times. Havard (1985) reported that from 1976 to 1983 prices of new equipment increased 4 to 5 times due to price increases and the removal of subsidies; equipment that had not been subsidized increased 2-3 times; peanut prices during the same period increased only 1.4 times. Coupled with these input price increases have been consumer price jumps in rice, cooking oil, and sugar. Farmers' complaints are understandable.

Economies in production is one way of reducing prices. Industries Chimiques du Sénégal (ICS) has reduced fertilizer production costs by switching to bulk blending. Lower prices for raw materials permitted further reductions. While the key to decreasing production costs is economies of scale, this is not on the horizon so long as Senegalese demand remains relatively weak and uncertain.

Although fertilizer prices have recently declined, the opposite is true for equipment prices.²⁶ Havard (1985) observes, however, that significant leeway exists for reducing these prices by removing various taxes which account for 29 percent of production costs. A reduction in the costs of transporting and marketing equipment, estimated to be an additional 30 percent over costs of production, may also be feasible. Another possibility is that the Société Industrielle Sahélienne de Mécanique, de Matériels Agricoles et de Représentations (SISMAR) should seriously think about producing less expensive models which respond better to current demand.

The most controversial means to reduce input costs to farmers is government subsidies. Fertilizer is one input which has traditionally been subsidized in Africa. In recent years, however, economists have come out strongly against the continuation of such practices.²⁷ Despite the strong pressure against fertilizer subsidies, the United States Agency for International Development (USAID) has agreed to a limited subsidy for 1985-88. The objective is twofold--to encourage fertilizer consumption and to discourage costly government credit and distribution programs. The subsidy is limited to fertilizer that is distributed by the private sector and sold on a cash-and-carry basis. Fertilizer sold by government agencies will not benefit from the subsidy. This means that SODEVA's program to introduce farmers to hybrid maize cultivation will not benefit even though maize is a crop which the World Bank credits with a sufficiently high fertilizer response to warrant temporary subsidies.²⁸ Given the low priority farmers place on fertilizer compared to food, seed, and equipment investment, it is likely that much of the financing for this subsidy will go unspent.

²⁶A seeder which cost less than 20,000 FCFA during the agricultural credit program cost approximately 50,000 FCFA in 1983 and now costs 72,000 FCFA.

²⁷See Shalit and Binswanger (1984).

²⁸See Shalit and Binswanger (1984).

Opportunities for Non-Crop Revenues

As shown in this study, those who can draw on other sources of revenue for social obligations and general consumption expenditures are more likely to invest in agricultural production. Increasing opportunities to earn non-crop revenues is another means to improve the farmers' capacity to invest in agriculture.

Agricultural Credit

The issue of agricultural credit in Senegal is extremely complex and has been the object of numerous studies.²⁹ The past history of debt default appears to have been carried over into the NPA (i.e., high levels of default for UNCA seed credit and SODEVA maize contracts in 1986), making it extremely difficult to recommend any type of broad credit programs for the future. The best approach is probably the one already announced by the UNCA--giving seed credit only to those farmers who reimbursed fully in 1986. Failure to give credit to those who paid would only reward non-payers and further jeopardize future programs.

The fact that farmers have expressed clear preferences for seed and equipment investments over fertilizer suggest that a fertilizer credit program would be ill-advised at present. Most farmers would buy fertilizer on credit and resell it (at significant losses) in order to purchase seeds or repair equipment.³⁰

While farmers expressed great interest in equipment credit, it is clear that few are ready to purchase--even on credit--implements at the current SISMAR prices. The equipment problem can be better addressed by finding ways to reduce production costs or provide credit for locally manufactured products.

²⁹See, for example, Tuck (1983).

³⁰Crawford, et al. (1985) found that retenue fertilizer which was sold by farmers was ultimately purchased by vegetable gardeners in Thiès and Les Niayes, thereby making no contribution to peanut and cereal production. If credit were made available now, the same scenario would probably occur again.

Alleviating Distribution System Constraints

If the private sector is to develop a viable input distribution system it must make inputs available when and where farmers want them; this requires good intelligence on farmers' needs and adequate, timely financing. Furthermore, the private sector must be consistent in policy statements and actions; this requires that the private sector and government work together to assure early announcement of any policies that influence distribution and assure that these policies do not change during the season.

Discussion in the third, fourth, and fifth chapters illustrated that there are two "private sectors" performing input distribution functions--the officially sanctioned activities of SONACOS, UNCA, ICS, and SISMAR, and the informal activities carried out in weekly markets. The informal sector appears to be doing a better job of providing inputs at times, locations, and prices which respond to farmers' needs. The fact that fewer than 50 percent of farmers have a personal means of transportation and that public transportation is highly geared to serving weekly markets (rather than Rural Communities or peanut collection points) must be recognized in designing input sales strategies. If the officially sanctioned private sector is to compete, it will have to establish a network of distributors capable of making small quantities of seed and fertilizer available in weekly markets. UNCA is a potential candidate, as are trucker/traders who frequent these markets. Trucker/traders' knowledge of the markets and farmers' buying and selling habits could provide the distribution system with valuable intelligence that is difficult for organizations such as SONACOS to collect. Such collaboration might reduce errors of overestimating demand for fertilizer and seed which involve costly investments in stocks that are slow to move. The extent to which these individuals are willing and able to participate in input distribution needs to be evaluated as well as the possibility of providing them with credit.

Farmers in general appear satisfied with the current informal marketing system for used and blacksmith-produced equipment. A possible exception to this is the non-availability of more durable factory made replacement parts. The general satisfaction with equipment markets may

change with time as the stock of seeders becomes increasingly dilapidated and local blacksmiths are unable to repair critical parts. It is unlikely, however, that SISMAR will find many clients for its 72,000 FCFA seeder even if credit is available. On the other hand, there could be a strong demand for factory made replacements of the critical seeder parts which blacksmiths cannot make well. Production and marketing of such parts might be a wiser business venture for SISMAR than a premature attempt to mass produce new seeders and other machines that local blacksmiths produce much more cost-effectively.

Government must also rethink its policy of relying heavily on village cooperatives as the conduit for input distribution as well as credit. To date village cooperative performance has fallen far short of expectations. This has been documented by a number of ISRA studies;³¹ it also surfaced as a concern at the recent seminar of agronomists (Thiès, May 5-10, 1986) that recommended legislation to give farmers more freedom to form legally recognized organizations for furthering their own economic interests. Also to be avoided is a situation whereby UNCA develops a monopoly on input distribution at the local level. As mentioned above, the UNCA relies heavily on support from the SAC and therefore does not completely fulfill government objectives for disengaging from the input sector. If the cost of input distribution is to be kept down and the efficiency of the sector improved, competition must be permitted. This means policies that encourage a good mix of farmer organizations, completely private sector operators, and joint government/private ventures such as SONACOS and ICS.

IMPLICATIONS FOR DESIGN OF EXTENSION AND RESEARCH PROGRAMS

We have inventoried farmers' ideas about the relative productivity and profitability of various inputs and agricultural practices. A logical next step is to collect data at the farm level to verify farmers' contentions, particularly when they differ from experimental research results. Among the most important issues to examine are:

³¹See Crawford, et al. (1985), Sarr (1985), Gaye (1986) and Niang and Sarr (1986).

1) Fertilizer response obtained on farmers' fields using their own cultural practices (late application, late weeding and thinning, little or no soil preparation, etc.). Research design should take into consideration inter-zonal and inter-annual variations in response and incorporate some type of probability analysis. Lack of reliable data on farmers' yield response is a serious constraint on any type of fertilizer price policy analysis.

2) The relative profitability of investments considered more profitable and less risky than fertilizer (banabana and livestock).³²

3) Farmers' expenditure patterns. An expenditure survey which provides detailed information on the allocation of revenues to various consumption and investment goods is essential if one is to get a better picture of the extent to which farmers are willing to invest in agriculture, and their effective demand for inputs.

4) The relative profitability of cereal and peanut production. Such information is essential if the government is to develop policies that will encourage increased cereal production.

5) The causes of very poor millet yields (particularly evident in Gossas). Agricultural investment will be constrained as long as farmers are unable to assure minimum food supplies. Farmers' complaints of insect and disease problems must be evaluated and solutions recommended.

6) The extent to which labor contracting practices and family obligations that perpetuate extensive agricultural practices can be modified to permit more intensive practices.

7) The relative performance of factory and locally manufactured agricultural implements. Such information is needed before the costs and benefits of different policies for equipment credit and distribution can be considered.

8) Systematic collection, analysis, and reporting of annual agricultural statistics. Timely dissemination of such information could

³²The "Productivité et pathologie des petits ruminants en milieu traditionnel" program in the ZOO/VETO department of ISRA is currently collecting data on the production of small ruminants by Senegalese farmers. Analysis of this data should provide useful information on the economics of small ruminant production.

help improve distribution systems to the extent that it identifies zones where seeds are likely to be in demand or revenues high enough to permit fertilizer investments.

There is also an important role for extension services, particularly where research results show that farmers' perceptions are not confirmed by actual experience. In these cases the extension services must organize information campaigns and demonstration fields to convince farmers that they are not using the best techniques or making correct economic assessments of returns to different activities.

Our research found that a serious constraint on the analysis of investment options by farmers is illiteracy and inability to perform simple mathematical calculations. Inability to keep simple records on amounts of fertilizer used and associated harvests hampers any type of systematic assessment of fertilizer response. Inability to perform simple mathematical calculations means that farmers make investment decisions by intuition rather than economic analysis. Extension services have to do more to increase literacy and numeracy among rural populations. If literacy is to be in local languages, then official documents recording agricultural transactions must also be in these languages.

Our research was conducted primarily at the farm level. Policy analysts need better information about other participants in the input distribution sector (traders/transporters, blacksmiths, farmer organizations, etc.), if they are to design policies that will provide these participants with the support needed to develop a distribution system responsive to farmers' needs.

In sum, our research suggests that the problem of agricultural inputs in Senegal will not be resolved by simply legislating a transfer of distribution responsibilities to the private sector. The government and donor organizations must recognize that the distribution system constraint is only one aspect of a complex system of factors that keep farmers from purchasing and correctly using modern agricultural inputs. In order to design policies which address the full range of constraints, collection of the types of micro-level information mentioned in the preceding list of research priorities is essential.

LIST OF ABBREVIATIONS

BAME	-	Bureau d'Analyses Macro-Economiques
BNDS	-	Banque Nationale pour le Développement du Sénégal
CSA	-	Commissariat à la Sécurité Alimentaire
ICS	-	Industries Chimiques du Sénégal
ISRA	-	Institut Sénégalais de Recherches Agricoles
NPA	-	Nouvelle Politique Agricole
SAC	-	Service de l'Action Coopérative
SISMAR	-	Société Industrielle Sahélienne de Mécanique, de Matériels Agricoles et de Représentations
SODEVA	-	Société de Développement et de Vulgarisation Agricole
SONACOS	-	Société Nationale de Commercialisation des Oléagineux du Sénégal
UNCA	-	Union Nationale des Coopératives Agricoles
USAID	-	United States Agency for International Development

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