



# *Market Improvements and New Food Crop Technologies in the Sahel*

**Impact of Technology and Marketing Strategies on Farmers' Incomes  
Progress Report 1**

**Production and Marketing Strategies  
Concept Paper 1**

**Food Processing and Marketing  
Concept Paper 2**

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## **Acronyms**

CIRAD	Centre de Coopération Internationale en Recherche Agronomique Pour le Développement
CRSP	Collaborative Research Support Program
DRAMR/SCLAER	Direction Régional d'Appui au Monde Rural/SCLAER (Regional extension office)
EWA	Entwicklungs Werkstatt Austria
FAO	Food and Agriculture Organization of the United Nations
FCFA	Franc de la Communauté Financière Africaine (CFA franc)
GIE TCL	Groupement d'Intérêt Economique
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Center
IER	Institut d'Economie Rurale (Institute of Rural Economics)
IFAD	International Fund for Agricultural Development
INRAN	Institut National de Recherches Agronomiques du Niger (Nigérien Agricultural Research Institute)
InterCRSP	International Collaborative Research Support Program
INTSORMIL	International Sorghum and Millet Collaborative Research Program
IRSAT	Institut de Recherche en Science Appliquées et Techniques (Research

	Institute)
ITA	Institut de Technologie Alimentaire (Institute of Food Technology)
NAD-1	Haoussa name of new hybrid sorghum from INRAN
NTENEMISSA	Bambara name of Guinea-type sorghum improved variety from IER
NGO	Non-Governmental Organization
PADER	Programme d'Action pour un Développement Rural
PDLM	Projet de Développement Local de Maradi
PPCL/EU	Programme de Promotion de Céréales Locales/European Union
RESOPP	Réseau des Organisation Paysannes Partenaires du PADER (farmers' organization)
ROCAFREMI	Réseau Ouest et Centre Africain de Recherche sur le Mil (millet research network for West and Central Africa)
ROCARS	Réseau Ouest et Centre Africain de Recherche sur le Sorgho (Sorghum research network for West and Central Africa)
SG2000	Sassakawa Global 2000
SMI-IMS	Sorghum and Millet Initiative – Initiative Mil/Sorgho
USAID	United States Agency for International Development

## PROLOGUE

This document contains the first Progress Report from our two-year project of adding marketing strategy and food-science inputs into ongoing NGO programs to introduce new sorghum, millet, and cowpea technologies to farmers' groups. We also concentrated on contracts between farmers' groups and processors.

The institutions involved were ROCAFREMI, INTSORMIL, NGOs, processors, and farmers' organizations in four Sahelian countries. After the Progress Report, two concept notes provide the marketing strategies (Concept Note 1) and processing lessons (Concept Note 2).

The Progress Report summarizes marketing strategies of the project. It also estimates program impact on farmers' incomes in 2002, separating technology and market- intervention effects. This report is based on fieldwork of the project leader and two economists in Mali, Niger, and Senegal in October 2002.

Concept Note 1 outlines the main marketing strategies and shows the importance of price variation. It also presents progress made in the first year of the pilot operation (2001) in all four countries, Burkina Faso, Mali, Niger, and Senegal.

Concept Note 2 discusses the food-processing perspective of the project. It is based on fieldwork of the project leader and food scientists from INTSORMIL and ITA in Senegal in January 2003. They evaluated the food-processing sector for processed products in Senegal and other countries and drew implications on what is needed to facilitate the rapid growth of the processing sector for millet and sorghum and analyzed factors related to the increased supply of uniform quality grain by farmers.

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# **Impact of Technology and Marketing Strategies on Farmers' Incomes**

## **Progress Report 1**

*Botorou Ouendeba, Tahirou Abdoulaye, and John H. Sanders*

### **Introduction**

In 2003 the results of the first year of the contract program between processors and farmers were evaluated with field interviews in Niger, Senegal, and Mali. We report here the estimates of the economic impacts at the farm level resulting from the increases in yields with the new technologies and the increases in prices from the marketing strategy. Since in most of the region 2002-2003 was a bad rainfall year, it is especially important to evaluate the ability of farmers to pay for the higher input levels with increased prices from various components of the marketing strategy.

In Burkina Faso, despite achieving reasonably good yields from the new technology, there was little interest among the processors in paying higher prices to farmers for a higher-quality product delivered later in the season. Sasakawa Global 2000 served as a principal buyer and is presently evaluating how to handle the sorghum purchased. In the other countries, the cereals have either been sold or set aside as family stocks for home consumption. Now the effects of yields and higher prices in Niger, Senegal, and Mali can be analyzed. The next trip will include a return to Burkina Faso to evaluate what happened to these stocks and how farmers' incomes were affected.

The operating rationale of the program is the need to utilize higher input levels on the traditional cereals, especially inorganic fertilizer and new cultivars. To pay for these inputs, farmers need to get higher prices. The program has a four-point strategy to obtain higher prices. This strategy is reviewed below. A critical interaction is expected between the introduction of the new technology and increasing prices so that more intensive production is profitable.

In this report, the strategy for price increase, the method of analysis of the results, and the fieldwork procedure are presented, followed by results from the three countries on increasing farmers' incomes. Some implications are presented in the Conclusions.

### **Strategy for increasing prices received by farmers**

#### **1. Post-harvest price collapse**

The primary cause of low prices received by producers of traditional cereals is the traditional price collapse at harvest. Farmers have a series of income requirements at harvest, including repaying farm and household expenses incurred during the crop season, taxes, school fees, marriages, naming ceremonies, and funding migrating household members. With so many

farmers selling at harvest, prices collapse. Merchants purchase and store at this time and take advantage of price recovery later. The farmer needs to wait and sell at least part of his harvest later. To put off the sale, the farmer needs credit or some other source of income and he needs to be able to store his crop and wait for the recovery.

Farmers' associations are increasingly being formed for storage and collective selling and lower-cost purchase of inputs. This can be done with warrantage (inventory credit) programs or with local credit associations willing to buy part of the harvest. Processors are often interested in dealing with farmers individually rather than collectively so they can profit from the seasonal price variation themselves.

Warrantage (inventory credit) programs are increasingly common in the Sahel. EWA, an NGO in Senegal, runs a good one with the objective to benefit farmers from both the seasonal price variation and a quality premium. A micro credit program in Cinzana, Mali has also been performing a similar role of providing credit for small quantities of millet. Farmers' bargaining power is increased by their working together and by obtaining more knowledge of the basic price problems.

## **2. Good-weather price collapse**

Basic staples have very inelastic demand. Good weather (or technological change or both) can result in a complete collapse of the price. People can eat only so much of their basic staple. Once people with the ability to buy have bought enough of the product, they don't want to eat any more. As there is no other market, the price collapses.

One solution is to aid in the development of the new markets that emerge with economic growth.<sup>16</sup> There is increasing demand for processed food products. In the Sahel this includes the improved white flour from better food varieties of sorghum, grits, couscous, and agglomerated products from millet including couscous. Infant food for weaning and for babies is also on the agenda for the companies with more skills in food science.<sup>17</sup>

In a later stage of development with economic growth, structural changes in the diet occur. There is a shift to animal products, fruit, and vegetables. The demand for feed grains increases rapidly and demand for food grains per capita declines. In this stage, developing countries have had to substantially increase their imports of feed grains. Planning to expand domestic grains for this market should have a high payoff.

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<sup>16</sup> Historic public efforts to support the price have generally led to cumbersome and large bureaucracies which have not been effective in supporting prices and had high costs. Donors are generally not willing to return to this alternative.

<sup>17</sup> They need to compete with the established but high-cost, imported Nestle product. They generally intend to do that with local cereals and legumes. But they have to produce a high-density product since the quantities that infants can consume are limited.

### **3. Poor grain quality**

The principal factor of concern to food scientists is to maintain the quality of the product. To do this, an incentive to farmers is generally necessary. The initial measure in the Sahel is to get threshing off the ground by distributing the “bache” (rug or sheet put on the ground to keep out the rocks and dirt when threshing). This “bache” was distributed in various regions of Mali. De-stoners, produced in Senegal, were also being introduced in several Sahelian countries.

Unfortunately, the price advantage of improved quality of grains is still very small in the Sahel. Farmers wanted 20 CFA/kg and some processors were willing to pay 10. Some processors even argued that they should only pay the market price. Since there would be savings of production cost when the processors do not have to take out dirt and stones, an educational process is needed for the processors.

Another quality factor is the introduction of improved cultivars in this program. Processors were asked to identify their preferred cultivars when the contract program was initiated. Just this cultivar was grown rather than the traditional mix produced by farmers.<sup>18</sup> There are two quality factors: (1) a uniform cultivar with a higher food quality, and (2) removal of dirt and stones usually found with the traditional techniques of threshing on the ground.

### **4. Government/NGO intervention in bad weather**

The primary poverty policy in most countries of the Sahel is keeping food prices down. As food prices increase with bad weather, government and NGOs distribute food with various degrees of subsidy. This food aid is often concentrated where yields are worse but quickly moves around the country. In Mali in 2002-03, the third year of adverse weather, the millet price went up to 165 and the government began distributing food. The price quickly fell to 150.

Sahelian governments need to find other methods of attacking poverty that do not depress farmers' incomes. Measures to increase the incomes of poor people would enable them to increase food expenditures even when food prices are high. This would benefit both poor people and farmers by increasing their incentives to use inputs and to make investments in their farm operations.

### **Four major objectives of this marketing-processing project**

1. Enable the farmers utilizing new technology to make a profit, thereby making millet and sorghum into “cultures de rente” (cash crop).
2. Increase the bargaining power of farmers, especially their ability to deal with processors and public policymakers in the new markets for sorghum and millet.

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<sup>18</sup> Producing a mix of maturity-level cultivars is a risk-reduction strategy for rainfall variation.

3. Improve the quality and increase the quantity of cereals available to processors at the appropriate times.
4. Improve the technical and managerial capacity of the processors.

## Methodology

In 2002-03, contracts were implemented in four countries in the Sahel. The objective of this progress report is to evaluate the impact of this contract program on farmers' incomes and to suggest methods to increase this impact. Income gains from introduction of the new technologies are distinguished from those from higher prices. In the future within the price effects, the various components will be separated according to the marketing strategy discussed above.

To estimate the two types of gains from new technology introduction and from better marketing practices, we compare the yields and prices received by farmers in the program with the yields and prices received by farmers not in the program.

<i>Components of Income Increase</i>	
◆	Yield increases. Use of inputs.
◆	Price effects: Sale at different periods during year. Price premium for quality.
◆	Bargaining power
◆	Governmental intervention

A fundamental hypothesis of this field research is the need for farmers to receive higher prices within years by (1) avoiding all of the sales of sorghum/millet that take place at the period of lowest prices after the harvest and between years, (2) moderating the price collapse in good-rainfall years with development of new markets, and (3) encouraging governments and NGOs not to dump imported cereals in bad-rainfall years and thereby depressing prices. With these higher prices, farmers can then pay for the critical higher input levels of inorganic fertilizers and improved seeds.<sup>19</sup>

## Fieldwork

Fieldwork for Niger was conducted in February 2003. Tahirou Abdoulaye, accompanied by Kaka Saley of INRAN,<sup>20</sup> visited all four villages (Saé Saboua, Mekki, Chadakori, and Sabon Machi) in the Maradi region and interviewed a sample of 40 farmers involved in the contract pilot operation. PDLM, the Swiss project staff, provided logistical support also. During this visit, the processors were not available for interview. A second visit in Niger June 10-15

<sup>19</sup> In the long run, processors will also need to pay a premium for a higher-quality product. Presently most processors in the region are small and many depend upon making money from this seasonal price fluctuation. They are functioning more as merchants than processors and seek to pay only the market price and buy around the harvest. An important, if not the main, part of their profits comes from speculation rather than processing. In the long run as quality food processors emerge, this will not be a problem. The yogurt producer in Senegal has no problem paying this quality premium.

<sup>20</sup> INRAN provided the logistical support.

included a meeting with Mme. Cissé Fatima, the main processor who signed the contract with farmers.

In Senegal, fieldwork was conducted June 16 through June 20, 2003. Tahirou Abdoulaye visited two villages (Mboulème and Gagnabougou) in the region of Mbour which are working with PADER-EWA, an Austrian NGO. Logistical support was given by PADER-EWA. With the help of Ababacar Ndoeye of ITA and Aly Sall, member of GIE TCL, Dr Abdoulaye then visited the region of Kaolack (village of Thiaré), the main millet area of Senegal. He also interviewed five millet processor, including Pierre Ndiaye, Yaourt Jaboot; Issa Nizar, PFA; Mme Deme, Free Work Service; and Mme. Coulibaly, La Vivrière. All these visits were conducted with Ababacar Ndoeye and Saliou Ndiaye.

In Mali, fieldwork started July 1, 2003. A team that included Botorou Ouendeba, John Sanders, and Tahirou Abdoulaye visited two villages (Kondogola and Zambougou) in the region of Ségou, Mali. The team was accompanied by Sandina Camara of SG2000. The NGO SG2000 provided all the logistical support to the team during its stay in Mali (July 1-19, 2003). The team also visited with cereal processors, including GAM (General d'Alimentation Malienne), La Sahélienne, Niang Abdoulaye, and Mamadou L. Diawara.

## **COUNTRY STUDIES**

### **NIGER**

A contract between farmers and processors was signed in 2002. The terms of the agreement specified that farmers could sell 100 tons of millet and 10 tons of sorghum to processors at a predetermined price of 115 FCFA/kg. When there finally was a sale, processors were able to buy only 22.4 tons of millet and no sorghum. This was a dry year and yields were down. But with an early improved cultivars, program farmers still had much better yields than other farmers.

Delay in the arrival of the processor and increases in the price of millet resulted in most of the farmers selling before the arrival of the processor. The millet price rose quickly after harvest in 2002-2003 due to bad harvest in neighboring regions (north of Maradi), increase in the warrantage operations of various development agencies, and millet purchase by the Niger government. The Niger government this year bought grain at harvest to renew its security stock of 60,000 tons. By selling their grain, most farmers made profits and kept only enough grain to sell at the contract to repay their input cost.

Improvement of the quality of grain is still an issue. The total grain gathered by farmers was 25 tons. After screening for stones and other foreign matters, the stock was finally 22.4 tons. Therefore, about 10% of the grain is still not at the quality level required for processing. Even though farmers do not thresh on the ground, the manual handling of the stock and packing process created some contamination.

Farmers appreciate the pilot operation because it allows them to have access to improved varieties, fertilizers, and fungicides needed for increased production. Despite the late start of the rainfall and drought spells, program farmers obtained higher yields than the average farmers. Average yields in contract fields were estimated at 850 kg/ha compared to 550 kg/ha on non-contract fields. This yield increase is the main source of income gain for farmers this year in Niger because the predetermined contract price did not allow them to take advantage of the seasonal price variation.

For the 2002-2003 cropping season, participants in the pilot operation had an average income gain of 13% per hectare compared to non-participants. This income gain is mainly due to the higher average yield of participants (850 kg/ha) compared to non-participants (550 kg/ha) because of the improved variety and inorganic fertilizer used for the pilot operation.

The income gain is also due to a price difference of 5 FCFA/kg between the harvest price of 110 FCFA and the contract price of 115 FCFA/kg. For this year, most of the income gain came from the yield effect (11%) with a price effect of only 2% of the total income gain

#### **Box 1: Warrantage (Inventory Credit)**

Farmers receive a credit against their grain stocks. Often they receive 90% of market value at harvest. Later in the year when prices are at their peak, the stock can be sold (within or outside the village) at market price at the time of sale. Farmers then repay the credit and receive the additional value generated by the sale. There are two dominant forms of Warrantage:

1. The credit is given to a farmer organization; therefore, any additional value is given to the organization instead of to individual farmers. The organization often uses the money to provide inputs and other everyday consumption products (for example, sugar, salt, tea, medicine) for the community. By buying in larger quantities, the farmer organization can attain cost savings.
2. The credit is given to the organization and the additional value is given back to members according to the amount of grain they contributed.

If farmers' prices were compared with market prices when they sold their millet, the price loss would have been 6%. There was an advantage to farmer' getting out of the contract. Farmers sold only enough at that price to pay for inputs provided on credit. They would have been better off selling their millet at the market price and repaying for their inputs in cash.<sup>21</sup>

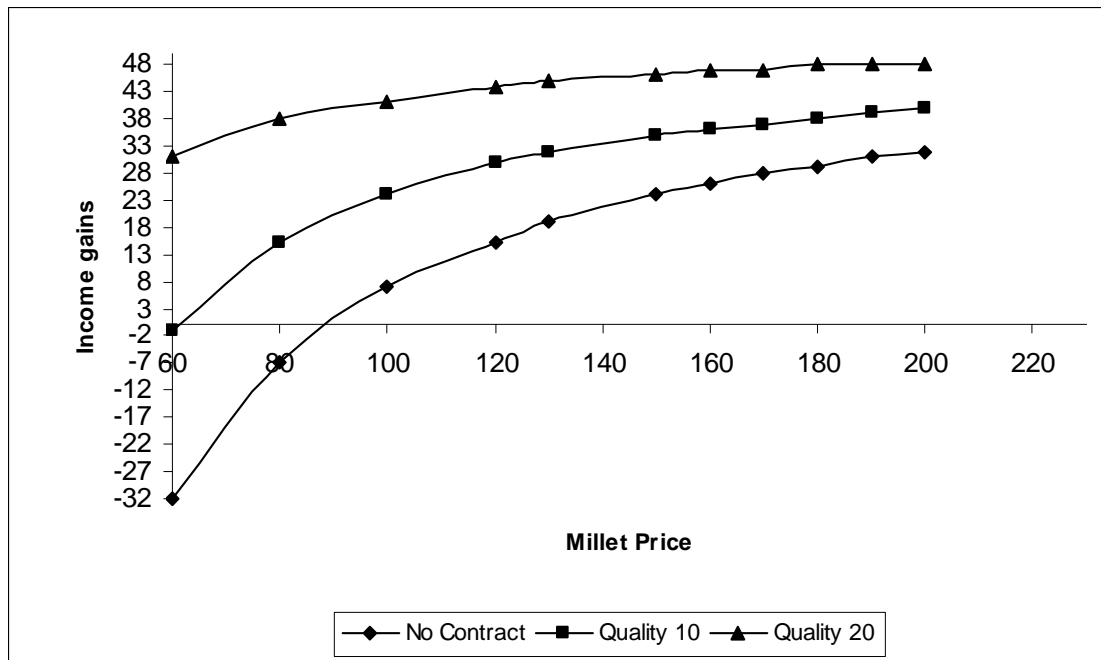
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<sup>21</sup> However, this attitude would have jeopardized the long-term relationship between farmers, processors, and the facilitator.

For the new season, farmers want a contract with the price to be determined at time of sale as the market price at time of purchase plus a 10 FCFA/kg price premium. The farmers are learning about negotiating for a contract and benefiting from seasonal price variation. Without contract, farmers would have received a higher market price for their production during most of the season. But they felt obligated to repay their inputs at the agreed price. The price gain above is calculated with the assumption that the farmers' alternative is to sell at harvest.<sup>22</sup>

The other part of the quantitative analysis is the break-even calculation. At what product price did the use of increased inputs become profitable in this poor-rainfall year? This depends on cost of inputs, output price, and incremental yield effect of the increased inputs.

Inorganic fertilizer was profitable only when the market price was at least 90 FCFA/kg<sup>23</sup> (Fig. 1). Note that market price at harvest in Niger is often 80 FCFA/kg or lower but the yield effect of fertilizer is also expected to be greater in normal and good rainfall years. In scenarios with a contract paying a quality price premium, inorganic fertilizer use becomes more profitable and farmers reach the break-even point quicker. With the 20 FCFA/kg, quality premium inorganic fertilizer use is profitable even at the low 80 FCFA/kg of millet (Fig. 1).



**Figure 1.** Income gains for participating farmers for three pricing scenarios, Maradi, Niger, 2003

<sup>22</sup> A more accurate calculation of the price gain (loss) would be from determining when the individual farmers sold their products.

<sup>23</sup> Based on the use of 50 kg of NPK and 50 kg of DAP per ha at respective prices of 200 and 240 per kg.

## SENEGAL

Farmers are organized into a farmers' organization called "Malicounda," which is scheduled to become a cooperative by 2004. This organization of the RESOPP<sup>24</sup> allowed farmers to obtain fertilizer at a lower price than the market price. They were able to purchase urea at 146 FCFA/kg while the market price was 200 FCFA/kg.

### Box 2: Savings and loans

A financial institution that allows farmers to borrow small amounts of money based on the amount of savings they have in the institution. There are several versions. The most common:

1. Loans to all members against collateral, often agricultural materials or bikes.
2. Loans up to a certain percentage of own savings.

With the help of the project, farmers were also able to hold their grain until market prices increased. They sold their grain for 200 FCFA/kg while the market price at the time of sale was 175 FCFA/kg in Dakar. The farmers' association sold a total of 12 tons of millet grain to a processor based in Dakar. There was a gain of 25 FCFA from not selling at harvest and a 25 FCFA premium for quality for a total

income gain from price increase of 11% on a hectare basis compared to non-participants. Yield gains in Senegal were relatively small this year due in part to the adverse rainfall conditions of 2002 and the fact that most farmers are already using inorganic fertilizers. Average yield for farmers involved in the program was estimated at 900 kg/ha compared to 700 kg/ha outside the program. Still the yield effect accounted for 16% of the income gain of the total income gain of 27%.

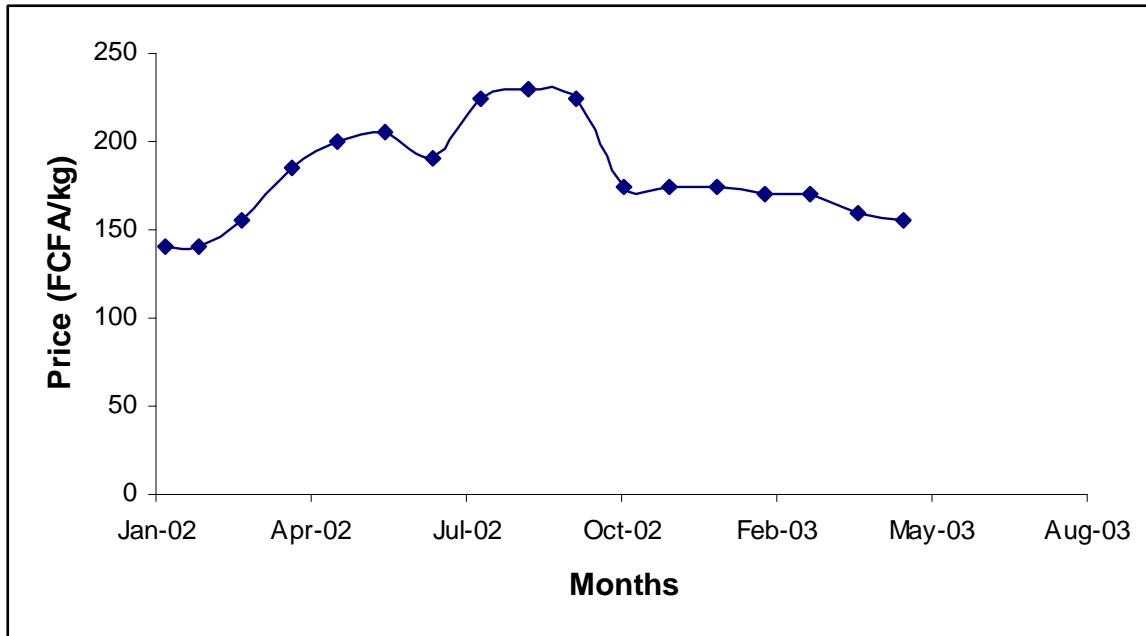
Even though rainfall conditions were adverse in most villages, the credit system had a noticeable success with reimbursement rates of 95-100% in the six villages.<sup>25</sup> The village of Seinthiou Badane had a 100% credit recovery. A total of 40 tons of NPK and 18 tons of urea were sold to farmers in the region by the PADER program in 2002. Millet is gradually being considered as not only a subsistence crop but also a crop from which farmers can make money.

Millet prices in 2002-2003 in Senegal remain quite high due to the bad cropping season (Fig. 2). Starting in October 2002, millet was 150 FCFA/kg and increased to 175 FCFA/kg by May 2003.

Farmers in the Mbour program with EWA took advantage of two of the three ways of increasing prices. They sold their grain later in the year when the market price was high and also received a quality premium. A larger yield effect from use of an improved variety and inorganic fertilizer would be expected under better rainfall conditions.

<sup>24</sup> Réseau des organisations paysannes partenaires du PADER This organization has more than 7,500 members across the country.

<sup>25</sup> Some farmers opted to repay inputs in cash. It was not clear if this was a result of low production levels or if they wanted to keep the grain for their own consumption.



**Figure 2.** Monthly millet price in Dakar, Jan 2002-May 2003

Source: TFPA-Issa Nizar

## MALI

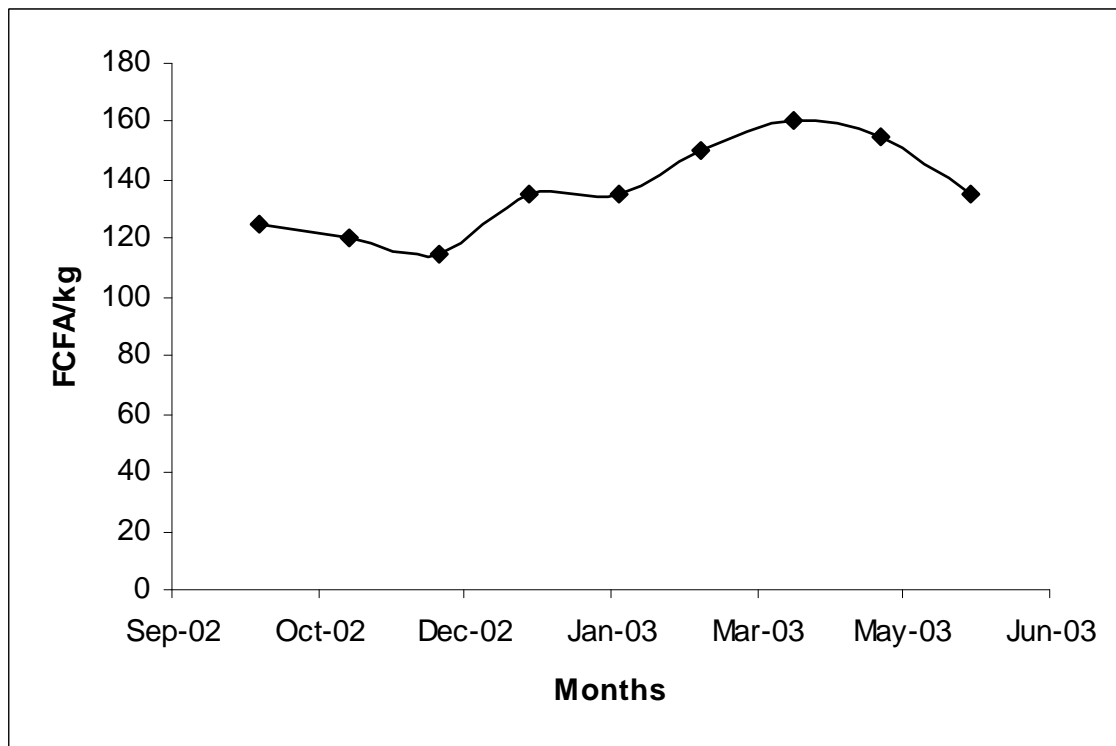
With SG2000 acting as facilitator, farmers in the village of Kondogola, Segou signed an agreement to grow millet to be purchased by processors based in Bamako. The contract mentioned that grain would be purchased at the market price plus a 10 FCFA/kg quality premium.

The millet variety, SANIOBA 03, was chosen by the processors based on the quality of its end products. Farmers were given seeds and inorganic fertilizers on credit. Even though the cropping season was poor (2002), farmers involved in the program had higher yields due to the fertilizer application than those not participating in the program. Farmers interviewed appreciated the pilot operation because it allowed them access to inorganic fertilizer, which they were able to repay with millet production. They noted that the contract pilot operation is teaching them a new way of making money from their production.

### Box 3: Cereal banks

The main objective of cereal banks is to assure grain availability to farmers during the hungry season. In this institution, farmers bring grains at harvest and sell to their local bank, which in turn will sell it back to farmers in the hungry season (often at lower than market price). In most cases, cereal banks sell grain only to villagers (often members only).

Yields gains were modest due mainly to the adverse rainfall conditions but participating farmers achieved higher incomes than non-participants. Based on the average yield of 625 kg/ha<sup>26</sup> reported in field interviews (compared to 450 kg/ha average yield for non-program fields), the average per-hectare income gain of participating farmers was 25% compared to other farmers. This income gain results from yield differences (4%) were minimal but were offset by the higher millet price (21%) received by those farmers who were members of the operation. Even though millet price variation was modest this year<sup>27</sup> (Fig. 3), the price effect dominated the yield effect due to the lower than expected yields of participating farmers.



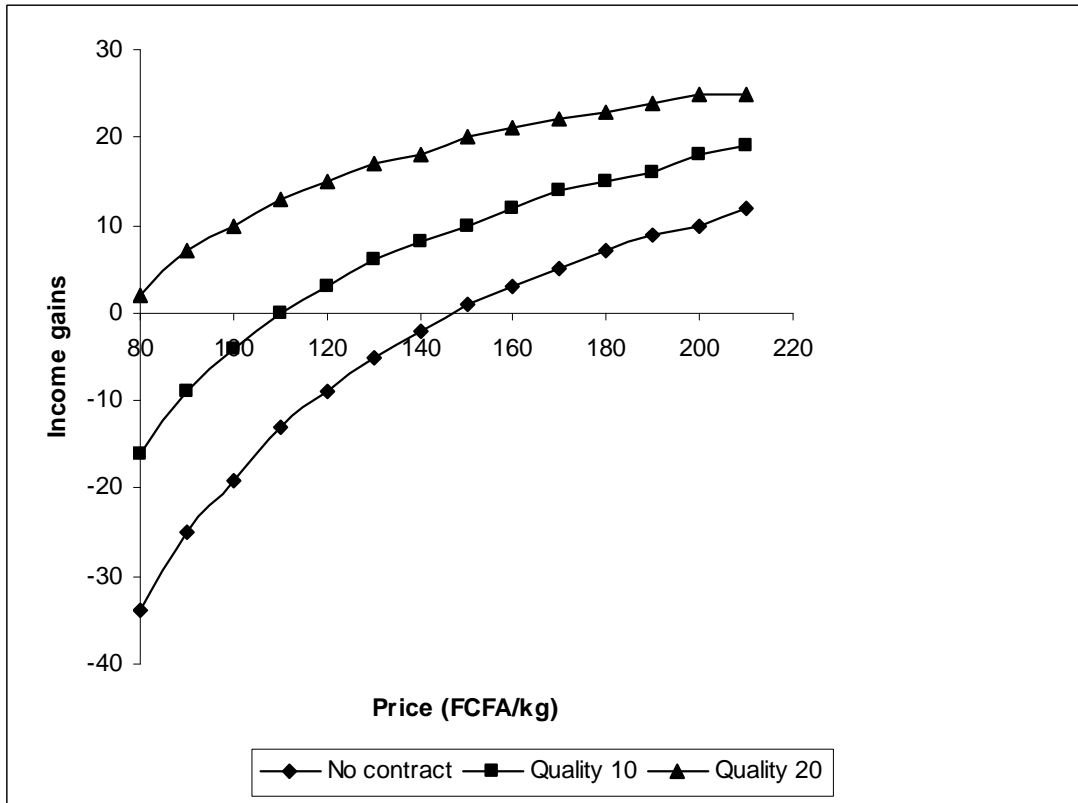
**Figure 3.** Millet price at Cinzana, Mali, September 2002 to June 2003  
Source: DRAMR/SCLAER, Segou.

The profitability of inorganic fertilizer use is evaluated with the break-even points for three pricing scenarios using crop budgeting (Fig. 4). Based on 2002 yield levels without contracts including a quality premium, farmers need to sell when millet prices are at least 140 FCFA/kg to reach the break-even point.<sup>28</sup> Introduction of a contract with a 10 FCFA/kg quality premium would make the breakeven point fall to 110 FCFA/kg. With an even higher quality premium of 20 FCFA/kg, income gains for members compared to those not using inorganic fertilizer are consistently positive even at low market prices (below 80 FCFA).

<sup>26</sup> Weighted average yield based on farmers' estimates.

<sup>27</sup> Farmers in the village of Zambougou, Segou reported free distribution by the government of 2 tons of grain last year.

<sup>28</sup> The breakeven point would have been lower if farmers had achieved higher yields.



**Figure 4.** Income gains for participating farmers for three pricing scenarios, Kondogola, Mali, 2003

**Table 1.** Per-hectare income gains<sup>29</sup> from the contract programs in the three Sahelian countries

	Niger	Mali	Senegal
Yield effect	11%	4%	16%
Price effect	2%	21%	11%
Total effect	13%	25%	27%

Source: Estimated from the field interviews.

In all three countries, income effects of the pilot operation were positive. Total effect is the lowest in Niger because of the type of contract signed by farmers. The predetermined price did not allow farmers in Niger to take advantage of the seasonal price increase. Fortunately, their yield effect was large enough to allow them a total income gain of 13%. In Mali, adverse weather conditions in Segou in 2002 did not allow much yield effect this year. However a significant price effect was realized when a 10 FCFA/kg quality premium was added to an already high seasonal market price. The highest income gain was obtained in

<sup>29</sup> Harvest-time price is considered the alternative to the farmers outside the program.

Senegal due to a good yield effect combined with a significant price effect. In Senegal, farmers also benefited from lower input (fertilizers) prices<sup>30</sup> and good market price.

### **Experience of the program in the first year, 2002**

2002 was a very dry year and yields were way down. Of the last six years in Mali 1997-1999 were good, 2000-2001 normal, and this year bad. With yields down, quantities of millet and sorghum available for sale were below what farmers had contracted. In Senegal and Burkina Faso, processors initially refused to buy; EWA and SG2000 became the buyers. The NGOs gave good prices and repayment rates for inputs were high.

Farmers are generally recognizing the need to buy inputs even after the bad experience of the dry year. There is awareness of the loss of soil fertility with higher population densities and the inadequacy of organic fertilizer. Fertilizer prices have been increasing and the importance of getting a good price for the millet/sorghum is becoming generally recognized. This is the main focus of the program.

In Niger and Mali, active governmental intervention has been affecting prices. In Niger, there has been purchasing to add to stocks, driving the prices upward and causing farmers to lose interest in the contract price. In Mali, with the bad weather, the government and NGOs have been subsidizing the grain prices of imports and driving down the sorghum/millet price (Fig. 3).

In Senegal, EWA bought 12 tons of millet from farmers when the millet price was low (90 FCFA in December 2001) and then sold it to the yogurt producer for 200 CFA/ kg in April 2002. Farmers later received the price difference after storage and financing costs. Of the various NGO/development projects, EWA had the best understanding of the bargaining-power problem and the necessity for farmers' groups to fight for their share and not just let the processors get all the gains from the seasonal price variation. Apparently, farmers will need interventions of these NGOs until they learn how to negotiate (fight) for their share.

### **Food science input into the project**

The development of new markets depends upon the business success and the continual evolution of those making new processed foods from sorghum and millet. The principal objective of the contracts is for farmers to increase their bargaining power and to get higher prices so they can afford to pay more for inputs. Farmers need to purchase fertilizer and improved cultivars since their soils have been mined of nutrients and new cultivars are needed to take advantage of higher input conditions.

The contracts also focus on assuring the supply of quality grain to the processors. The first requirements on the quality side are a uniform and higher-quality variety and to avoid threshing on the ground. Threshing on the ground leads to dirt and stones being mixed in

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<sup>30</sup> We did not estimate the income effect from the lower fertilizer price resulting from the bargaining power of the farmers' organization. We need to do this.

with the cultivars and requires laborious hand-cleaning by the processors. Threshing techniques vary and the simplest improvement is to put a “bache” (sheet or rug) down on the ground. Then threshing can be done with sticks or by driving over the bache. Clearly the next technical improvement needs to be threshing machines at the farm level.

To support the processors, the project proposes the collaboration of food scientists from INTSORMIL and from ITA, Bruce Hamaker, Lloyd Rooney, and Ababacar N’Doye. They would provide technical inputs to the processors. This would consist of technical advice and training courses. This would be for the food-science element of the training. Management training would also be made available as from the Nebraska Food Producers Institute.

## **Conclusions**

1. Farmers appreciated the access to inorganic fertilizer and improved varieties of millet even though yield gains were modest due to bad weather. Farmers can receive input credit for millet production and repay it if they receive higher prices.
2. Holding their grain until prices recover allowed farmers in Senegal and Mali to receive higher prices. In Mali the gain was only 10 FCFA/kg above market price while in Senegal farmers were able to obtain 25 FCFA/kg above market price.
3. In Niger, market price went quickly above the contract price and most farmers sold their grain and realized some profits. In the new contract, the price-determination method will be changed to market price at the time of sale plus a quality premium (10 FCFA/kg).
4. The number of farmers wanting to participate in the program is increasing. In Mali, the program is starting in a second village this year. In Senegal, the processors’ association has begun a relationship with a group of farmers in the Kaolack region.
5. Quality improvement of grain is the next big challenge in delivery of clean grain to processors. Currently, “baches” are being introduced to keep threshing off the ground but this still is insufficient. In Senegal (Kaolack region), some professionals are already offering threshing-machine services. Introduction of threshing machines in other villages would greatly improve the quality of grain.

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# Production and Marketing Strategies

## Concept Paper 1

Botorou Ouendeba, Tahirou Abdoulaye, and John H. Sanders

### Summary

A four-country program with contracts between farmers groups and processors was implemented in 2002. This program will be expanded in 2003 for larger contract quantities and a major effort will be put on quality improvement of the grain. Also explored will be the potential for doing contracts with the feed mixers in Senegal to provide high-quality millet to substitute for the imported maize.

The yield gains from adequate inorganic fertilizers are already appreciated by farmers and will be even larger for normal and good-rainfall years. Enabling the farmers to sell later than the post-harvest price collapse is expected to be the principal economic factor to assure their ability to pay for higher input use especially inorganic fertilizers presently. As the seasonal price differential declines over time,<sup>31</sup> a longer-run strategy is to increase their marketing power. The risk-insurance project will be concerned with income loss from higher-input use in the 10 to 20% of the time in which climatic conditions are very adverse.<sup>32</sup>

This strategy still leaves the major problem of the price collapse in good-rainfall years.<sup>33</sup> To handle this problem, alternative markets need to be developed. Therefore, another major component of this project is to work with processors to make sure that they are successful and evolving. This includes not only producers of new food products but also feed mixers and other users of livestock feed products. As incomes grow in these countries in the next five to 10 years, the demand for livestock products and for feed will expand very rapidly. At the same time, consumers will begin to decrease their consumption of the basic grains and root crops.

Increasing the market power of farmers is an essential component of the marketing strategy. Development of cooperatives will enable farmers to have more market power in both input purchases and product sales, thereby facilitating the increasing production of high-quality grain. The latter will enable the further development of new food products.

Selling on contract requires an educational process for both farmers and processors. This is especially true in Sub-Saharan Africa with its tradition of top-down or guided development and excessive use of subsidies as policy instruments. Therefore, increased interaction

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<sup>31</sup> The principal project focus to date is on obtaining benefits for farmers from the annual price variation. Over time, this variability will be reduced or eliminated as producers participate in storage programs.

<sup>32</sup> This has traditionally been covered by welfare relief. This project would be developing the mechanisms of insurance to gradually move farmers away from the need for most emergency relief.

<sup>33</sup> This problem is aggravated when there is rapid technological change, as with the rapid increases in maize yields before the collapse of the maize price from 150 Birr/quintal to 30 in 2000-2001.

between processors and farmers will be facilitated. Training and travel between sites will be important project components.

## **Introduction**

Pearl millet and sorghum, the two most important food crops in the Sahel zones of Burkina Faso, Mali, Niger, and Senegal, will continue to dominate the production systems. More than 40 million people (population growth: 3% per annum) live in this SAT region with an urbanization rate ranging from 17% in Burkina Faso to 45% in Senegal. The two rainfed cereals intercropped with cowpea are well adapted to the harsh crop- growing conditions of the eco-system. In Africa, more than 40 million hectares of millet (20.1 ha) and sorghum (21.6 ha) are grown each year. In the last two decades, the yields remained low but production increased significantly due mainly to area expansion into the marginal zones that rapidly eroded the natural resource base. Increases in food production are constrained by limited soil fertility, low moisture, and inappropriate cultivars.

There has been substantial research on the production of basic food staples in West Africa. These crops include millet, sorghum, cowpeas, and cassava. These activities have been led by the international research centers, and in the last two decades substantial contributions have been made by the national research programs and the international research networks, including ROCAFREMI and ROCARS. Also in the last decade there have been substantial gains in food-technology research. The processing of new products from traditional cereals and other foods has been facilitated and new machines developed, such as the grain cleaner designed by ITA/ROCAFREMI in Senegal for removing dirt and stones from threshing on the ground.

For all these basic food crops, continuing soil exhaustion makes the use of soil-fertility improvements, especially inorganic fertilizers, a critical activity for increasing and stabilizing yields. However, to pay for these inputs (inorganic fertilizers, improved seed, and seed treatment), higher prices are necessary for the basic food crops. Food prices collapse at harvest and farmers are forced to sell because of numerous requirements they have for cash at this time. Governments, donors, and NGOs with food aid continue to depress cereal prices to benefit urban consumers and the rural poor. In good climatic years, the bottom falls out of cereal prices. All these factors tend to depress food prices, thereby reducing the incentive to intensify production.

## **Objectives**

- Increase quality millet, sorghum, and cowpea grain production through the adoption of improved technologies in the pilot countries (Burkina Faso, Mali, Niger, and Senegal).
- Increase farmers' incomes through the development of a strategy leading to a regular supply of quality grain through forward contracts, taking into consideration the market's need for consistent quality grains.

- Exchange information both at national and regional levels, facilitating decision-making of the actors involved in the supply chain.

## **Major activities**

A marketing strategy is needed to ensure that farmers producing basic food crops more intensively receive higher prices and therefore can continue to pay for their inputs. This project is principally concerned with improving the marketing environment so that farmers can earn sufficient incomes to take advantage of the available production technologies. These farmers can then increase their marketed surplus and welfare by earning increased incomes from the basic food staples.

Three principal components of the marketing strategies are proposed. The focus of this concept note will be on explaining these three and then doing a preliminary evaluation of the performance of the ongoing fieldwork with farmers, in making contracts with them, and operationalizing this strategy in the first year of the project. After reviewing the ongoing project, there are sections with lessons learned, then priorities for Year 2, and finally some conclusions.

Once the marketing strategy has progressed into the implementation stage, there will be increased attention to providing technical inputs into the processing industry and to the further evolution of the input industries<sup>34</sup> to support the food-crop production sector. As field agricultural production problems emerge, there will also be a component to support the contracting of specific demand-driven research to be undertaken by the NARS.

## **Production and marketing strategies**

The first and most significant factor to increase farmers' incomes is to introduce new technologies, especially improved varieties, seed treatment, and inorganic fertilizers (Table 2). To pay for these increased inputs, a marketing strategy is needed to increase prices received by farmers and to facilitate the observed shifts of millet and sorghum into cash crops.

To earn more from their basic food staples, farmers need to use value-added and strengthen their bargaining positions on obtaining production inputs and in selling grain. Concentrating first on value-added for the basic cereals, millet and sorghum, there are basic improvements in their marketing that need to be made to increase the product price received.

Most cereal producers feel strong pressures to sell their products that are not going into subsistence storage at the post-harvest price low. Merchants and processors are happy to take advantage of farmers and buy their cereals and hold them until the price recovers. There are

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<sup>34</sup> Presently, these input activities are being handled by strong NGOs but the second stage of the project will be concerned with new markets as in the feed industry and with the process of having these input services taken over by the local private sector. The sustainability of this evolution of product and input markets is then central to this proposal.

Table 2. Priority strategies for increasing farmers' incomes

Strategies for increasing farmers incomes	Potential for income increase	Current status in the region
1. Use improved technologies (improved varieties, inorganic fertilizer, fungicide)	Large yield increases possible here but they need to be combined with better prices from avoiding sale at the post-harvest low. Otherwise production increases can drive down the prices.	Potential in region. Yield gains observed in pilot project in all four countries in spite of late and irregular rainfall. Farmers appreciate the effects of inorganic fertilizers.
2. Take advantage of seasonal price variation (inventory credit)	This is the key change that will increase farmers' incomes until a large number of farmers do it. Then the seasonal price variation will disappear.	Inventory credit or inventory-credit programs are increasingly found all over the Sahel for different food crops.
3. Increase market power of farmers	Most important long-run strategy and will enable farmers to get lower input prices and bargain better with processors.	Need to organize farmers' groups and then co-ops.
4. Produce premium-quality grain	5 to 10 CFA/kg if don't thresh on the ground. More for production of improved quality cultivars.	First farmers have to get threshing off the ground and then concentrate on high grain quality cultivars.

combinations of required consumption and production expenses that put pressures on farmers to sell at the post-harvest, price-collapse period. Farmers' cash requirements include taxes, school fees, labor costs from the production season including compensation to family members with gifts, financing family members to go off to work in other regions outside the the crop season, repaying loans for personal expenses such as medical expenditures or food during the hungry period, for inputs such as fertilizer and seeds, and finally expenses for marriages and naming ceremonies. Farmers in Sahelian villages can quickly cite these pressing needs for cash occurring at harvest time.

There is substantial within- and between-year variation of the millet and sorghum prices. Table 3 documents the millet-price variation observed and expected for this crop year. It is based on interviews with farmers during a month of field interviewing in October 2002. For farmers to be able to pay for inputs, the first requirement is that they wait for the post-harvest price recovery after the harvest-price collapse. Farmers need access to storage and credit to respond to their cash requirements for the post-harvest period. The first part of value-added promoted here is to enable farmers to sell three to 10 months after the harvest and thereby obtain the seasonal price recovery for themselves.<sup>35</sup>

<sup>35</sup> When there is a major between-year price collapse, as in Ethiopia for maize in 2000-2001 due to the combination of rapid technological change and good weather, the maize price can go down and stay down due to the large surplus accumulation and the lack of alternative markets. To handle this between-year price collapse, the development of alternative markets will be critical. The domestic feed grain market will be evolving soon in many African countries. Infrastructure improvements can decrease the costs of moving grains between regions and countries.

Table 3: Current and expected millet prices in four Sahelian countries, Oct. 2002

Country	October 2002 millet price (FCFA/kg)	Expected price at millet harvest in 2002 (Nov.-Dec) (FCFA/kg)	Expected peak during the hungry period, 2003 (July–Sept. (FCFA/kg)
Niger	100	80	230
Senegal	250	100	300
Burkina Faso	140	75	220
Mali	168	90	225

All over the Sahel, inventory-credit programs are now being utilized by various NGOs and other donors to obtain inventory credit for farmers so that they have cash at harvest but do not have to sell their cereals then. The guarantee of loan repayment is the value of their stored cereal locked up in storage at the village level. Then either they or the cooperative representing them can sell the grain later in the season. Once it is sold, the loan to the farmers is repaid, with storage and interest costs deducted. The farmers or the cooperative<sup>36</sup> then makes the profit from the price recovery. As more farmers engage in inventory credit, the seasonal price variation will be reduced. However, enabling farmers to take advantage of the seasonal price variability is expected to be the largest marketing price gain<sup>37</sup> available to them.

Processors with storage facilities and the traditional intermediate marketing people will also want to take advantage for themselves of this same seasonal price variation. However, to encourage the farmer to use higher input levels and to make traditional food crops into cash crops, farmers need to take advantage of seasonal price variation.

The next value-added is to produce a higher-quality cereal grain. To reduce risk, farmers produce a number of different cultivars in their field, i.e., product of out-crossing plants such as millet is affected. Also, threshing is often done on the ground, thereby adding dirt and stones to the grain mixture.

This project proposes handling the seed mixture by introducing specific improved cultivars in each of the four countries. In many of the farmer “groupements,”<sup>38</sup> threshing on the ground still took place. There are many ways to get around this. Putting a plastic (“bache”) down on the ground is done by some farmers. Simple threshers can do the job; larger farmer organizations can afford to have their own thresher. A seed-cleaner machine was developed by ITA, the food-technology agency in Dakar. The gains to processors from not having to separate the dirt and stones are substantial. Several processors stated that it takes one worker

<sup>36</sup> Since the farmer is a shareholding member of the cooperative, he benefits from the increased profits of the cooperative.

<sup>37</sup> Note that the biggest income gain is expected from raising yields with new technologies but this has to be combined with higher prices. It is the combination of technology and marketing strategy that results in higher incomes.

<sup>38</sup> Defined as small groups of 10 to 20 farmers. These groups often borrow together and put group pressure on all the members to repay. Various “groupements” would be combined in a cooperative.

a whole day to clean a 100kg sack of grain. There will be conflict between the processors and the farmers about the payment of a premium quality price. Processors would like to have a high-quality product at a minimal price. Farmers have not only to make these investments in a higher-quality product but they also will have to fight for the price premium.

The high-quality processors developing new products expressed their willingness to pay this premium and they are expected to be the industry leaders. The more marginal producers and those principally oriented to searching donors and governments for subsidies have resisted paying a quality-price premium. But these are not the processors who will expand and drive the industry.

There are two important components to farmers' receiving higher prices in the initial stage of this project. First they need to take advantage of the seasonal price variation by selling later. To do this, farmers need to use storage and to obtain inventory credit. The second part is to obtain a price premium for a higher-quality product.

These gains to the price received by farmers will often be contested since traditional marketing people and processors will try to capture them themselves. It is necessary for farmers to organize themselves, as into cooperatives, to have sufficient market power to compete for these price gains. With a larger number of members, farmers can invest in storage, threshers, and grain cleaners. They can negotiate for lower fertilizer prices by buying in quantity. They can also produce sufficient quantities of grains so that processors, needing regular quantities and qualities, will be prepared to pay a higher price.

But as with negotiating any price in the market, farmers' groups will need to refine their marketing skills and be prepared to look for the best buyers (and sellers). The processors will always be trying to increase their profits as much as they can. Markets include conflict as well as cooperation and farmers' groups will have to identify the good processors who are willing to pay premium prices for high quality and deal with them and make sure that they prosper. This requires an evolution of attitudes on the part of both farmers and processors. This process of market power and tough negotiation is most advanced with EWA in Senegal. This is discussed more below.

### **Progress to date in production and marketing gains for farmers**

In the first year of the pilot project, four contracts were developed<sup>39</sup> between food-crop producers (millet, sorghum, and cowpeas) and processors. Different NGOs served as intermediaries. The four participating countries were Niger, Senegal, Burkina Faso, and Mali.<sup>40</sup>

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<sup>39</sup> The concept of a contract is just being developed. Processors did not sign in Mali but they did discuss. In Senegal there was no price or timing agreement. The cooperative of EWA just gave the processors the first preference in buying at the market price in March plus a price premium.

<sup>40</sup> The fieldwork consisted of interviews with farmers in the "groupements" contracted and interviews with the processors and the NGOs. All have been very supportive but we are especially grateful to the Swiss Development Project (PDLM) in Niger, EWA in Senegal, Global 2000 in Burkina Faso and Mali, and Winrock International in Mali.

## NIGER

Two entrepreneurs contracted for 110 tons of millet, 10 tons of sorghum, and five tons of cowpea with farmers' groups. They agreed to pay 115 CFA/kg for millet in November. The price then was expected to be around 80 and it was already 100 CFA/kg (in mid-October 2002) since the harvest had already begun. This is a substantial premium price but with minimal gains for inventory credit.

The quality of the grain was reduced by the poor seed quality being produced by INRAN followed by poor roguing and inadequate isolation by the farmer seed producers. Threshing is done off the ground by women. So the quality is reasonably high since it is not mixed with impurities. Also the substantial potential for gains to inventory credit is indicated in the seasonal price variability for millet in the Maradi region of Niger in 2001-2002 (Fig. 5).

There is a contract provision that the entrepreneurs will pay only for the high-quality grain and there will be separation by size at purchase. This was discussed in the field but it will still be a shock for farmers if the quantity rejected is very large. This is an important implementation factor that will be followed and reported. Farmers and processors have a learning process to make contracts and this is the first year of this project (Table 4).

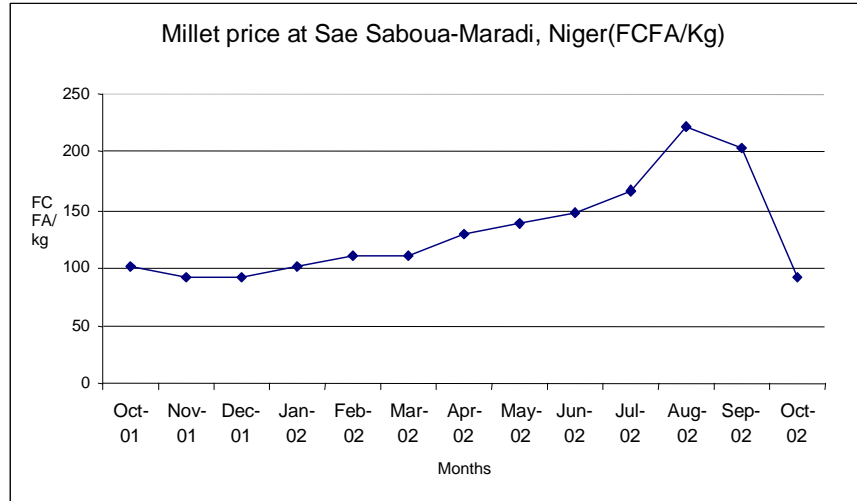
Neither the farmers nor the processors expected to pay for the bags or for transportation to a regional center for quality evaluation. Some evolution of the contract process is necessary. A principal factor making this system work so far has been the apparent high level of trust between the INRAN food technologist and both farmers and processors and between the Swiss Development Agency program and farmers.

Table 4. Processors involved in contract process for millet products in Niger

Processors <sup>a</sup>	Millet processed monthly	Products sold
STA – Mme. Cissé Fatchima	5 tons	Infant food
GIE <sup>a</sup> – Mm. Abdou Mariama	1-2 tons	Dégué, couscous, massa
GIE – Mme. Aïssa Guirmey	NA	Couscous, bourabousco, dégué

<sup>a</sup> A GIE is a cooperative, in this case an association of women processors.

In the future, Nigerien farmers could use more inventory credit and the seed producers could increase the quality of their product. Processors and farmers also need to interact more to understand each others' problems so the contracting process can evolve. Nevertheless, the contract seemed to be a fair interaction, with each side getting something. Niger has the potential to be a major supplier of millet products. After Niger, it is the largest millet producer in the world.



**Figure 5.** Farmer estimates of seasonal millet prices in the Maradi region of Niger October 2001 to October 2002

## SENEGAL

The Austrian NGO, EWA, has a long-term commitment to develop farmer cooperatives in Senegal. It estimates that in its six cooperatives in the former peanut zone, there will soon be 8,000 members. EWA encourages modern production methods with inorganic fertilizer and improved cultivars. It specializes in storage facilities and technologies and controls cowpea storage insects with Phostoxin and double-sacking. It has invested in threshers, cleaners, and dryers. Due to poor millet harvests in 2001 and 2002, EWA has not been very involved with millet. But it wants to expand its activities into the Kaolack area, the center of millet production.

The regional cooperative units utilize inventory credit and are producing a higher-quality product, but they could not come to a contract agreement with processors on approximately 100 t of millet. They agreed that in March, when farmers wanted to sell their millet at the market price plus a premium, the cooperative would give the processors with whom they negotiated the first option to buy the millet. The implicit threat is that the cooperative can find other buyers. The EWA serves as a useful model for the region in attempting to take advantage of all three components of the marketing strategy for increasing the price received by farmers, inventory credit, premium price for quality, and market power.

In Senegal, the processing sector is also the most advanced in the region. Only five of the processors were interviewed (Table 5). A separate document funded by the project cites 11 processors so the total millet requirements need to be approximately doubled<sup>41</sup> (ROCAFREMI, 2002: 12, 13).

<sup>41</sup> Estimates of purchasing over time needs to be improved as many processors decrease or cease their purchasing when the prices go up seasonally. We need to begin obtaining more comprehensive data from the processors on annual purchases and seasonal changes in purchases.

Table 5. Millet processors<sup>a</sup> interviewed in Senegal

Processors	Millet processed monthly	Products
Les Mamelles Jaboot (Pierre N'Diaye)	6 tons	Tchakri-yogurt
Free Work Services (Mme. Dene Aïssatou)	7-20 tons	Arraw, tchakri, dégué
Mme. Josefina Dione	20 tons	Idem
TFPA (Issa Nizar)	15 tons	Semoule, tchakri
AGC (Mamadou Sow)	10 tons	Infant food, semoule

<sup>a</sup> In Senegal 11 processors were producing millet products included in ROCAFREMI (2002, pp. 12, 13). The five above were visited in this fieldwork. A more complete list of processors in Senegal is in IMS, 2002.

There are a series of new millet and cowpea-based products, and exports have been rapidly growing. Incomes in Senegal are higher than in the other Sahelian countries. Hence, the consumption patterns being observed here serve as a model of how things are expected to evolve in the other Sahelian countries.

The main constraint is that producers will need much larger supplies. The producers have also not gotten the idea that they will have to pay more for quality grain and that the cooperative will take the gains of inventory credit for its members. Some of the processors producing higher-quality products understand the need to pay more for quality and don't have the capacity to do their own storage. Others feel that both of these price advantages have to be contested with farmers. More interaction between the two sides will be important in the future. Processors have to recognize the importance of farmers' making money and utilizing new technologies to increase their productivity and the quality of their products. Farmers need to recognize the importance of fulfilling contracts and providing regular supplies of high-quality grain.

## BURKINA FASO

Global 2000 has been providing improved cultivars of millet and the red sorghum, Framida, with seed treatment and 100 kg/ha of inorganic fertilizer. The processors have resisted any discussion of a premium price but purchasing has been spaced over several months so that some of the gains from the seasonal price increases will be obtained by farmers. Red sorghum is primarily utilized for traditional beer production. This is a traditional use rather than an expanding use. The new white sorghums are expected to have a higher potential quality premium due to the larger number of potential uses in processing. It will be important to get an improved white sorghum into these trials as soon as possible (Table 6).

Here the processors and even those identifying the new technology need to rethink the variety strategy. Farmers need to produce a high-quality product which can be used for new products. Processors need to spend some time in Senegal to see the new range of products coming out. Sorghum is generally threshed on the ground and this needs to be changed by

putting something down (“bache”) so that quality is increased. The quality will be increased, especially if high-quality sorghum is introduced along with the high-quality millets. There is the problem of educating processors so they can benefit from the reduced production costs of cleaner millet and sorghum. They need to realize these gains and pay a quality premium.

Table 6. Millet processors in Burkina Faso

Processors	Millet processed monthly	Products
Mme. Zoundi	NA	Millet products including cakes and croissants
Beogo Soama (head, cereal producers association)	NA	Concentrates on maize products, millet flour.

## MALI

Two very good NGOs are dealing with farmers in Mali and introducing the improved millet cultivar (Sanioba 03), inorganic fertilizers, and seed treatment (Apron star). Farmers have substantial confidence in Global 2000 and appreciate the fertilizer even though millet yields in 2002 were only 800 kg/ha to 1 mt/ha due to irregular rainfall. With good rainfall, farmers expect 1.8 to 2 mt/ha with these inputs. This is probably overly optimistic but yields of 1.2 to 1.4 mt/ha would still be a substantial improvement.

The processing sector in Mali is advancing rapidly and is only second to Senegal in the region. La Corbeille (women’s cooperative with 15 members), Sahelian (Mme. Amsitu Hydra), and UCODAL (Mme Mariko) all were involved in both exports and domestic sales and have substantially increased sales this year of fonio and millet products (Table 7).

Table 7. Millet processors interviewed in Mali

Processors	Millet processed monthly	Products
Mm. Diop	0.5 tons	Moni-Ku (bouille), Dégué, tchakri, couscous
La Corbeille GIE (Mme. Coulibaly)	5 tons	Idem
Sahelian (Mme. Haïdara)	7 tons	Idem
UCODAL (Mme. Mariko)	NA	Idem
Mr. Niang Abdoulaye	3.5 tons	Dégué, tchakri, couscous

Contracts were discussed but never signed by processors but all three of the above companies were in agreement with paying a premium for higher quality. As in Burkina Faso, threshing is predominantly done on the ground resulting in a very dirty product. As in Senegal, a rapid growth of consumer demand is occurring as the better firms mentioned above are producing quality products. Both domestic and international demands are growing rapidly over the last two years. There will be continuing pressure to obtain larger quantities of a clean, high-quality grain.

## Lessons learned

This project will be built on lessons learned from the results of the different NGOs and projects and networks in the region. In Mali and Burkina Faso, SG2000-implemented activities related to millet and sorghum intensification using improved technologies. SG2000 also developed a strong program on farmers' training and on post-harvest technologies. CIRAD and the two commodity networks for sorghum and millet (ROCARS and ROCAFREMI) made significant contributions to increase production and promote the food technologies. The central focus of the Sorghum and Millet Initiative project, funded by IFAD, SG2000, and the French Cooperation, is to encourage large and small-scale food processors to invest in millet and sorghum product line development (Table 8).

Table 8. Summary of program strengths in the first year of operation

Strengths
1. Strong NGO agencies working with farmers
2. Excellent technologies available in most countries both for production and processing
3. High potential yield increases for millet and sorghum (not completely attained in 2002 due to late and irregular rainfall)
4. Quality seed in Senegal, Burkina Faso, and Mali
5. Input financing available
6. Advanced inventory-credit systems being used in Niger and Senegal (see note below)*
7. Signed contracts in Niger and Burkina Faso
8. Progressive processors are mostly women
9. High-quality processed products in Senegal
10. Rapidly increasing domestic and international demand for processed millet products

\* In item 6 the inventory-credit system refers to a number of programs in Niger but not this one. In contrast in Senegal, inventory credit was a principal element of the EWA marketing strategy.

Farmers appreciated the new technologies introduced, especially the inorganic fertilizers. They are generally becoming aware of the gains to selling later after recovery from the harvest-price collapse. Three of the four contracts agreed upon included some gains to farmers from not selling at the post-harvest price low.

The quality of the final product is still generally a serious problem. In Burkina Faso and Mali, farmers have to stop threshing on the ground. In Niger, the seed quality was very poor resulting from poor seed-production techniques in INRAN and by the farmer seed producers. In Burkina Faso, an inappropriate sorghum variety for traditional beer rather than one of the new white sorghums was grown. In the next season, threshing has to be gotten off the ground and seed quality improved by better isolation and roguing. New white sorghum varieties need to be identified in Burkina Faso and put into these contracts on farmers' fields.

The negotiation process is just beginning and there needs to be more contact between farmers and processors. Processors need to go out and make contacts with farmer groups so that both sides can better understand each others problems and needs.

Farmers' groups need to get larger in most countries to follow the model of Senegal. In Senegal the cooperatives have sufficient membership to invest in threshers and storage facilities. The cooperatives are also big enough to be tough negotiators with the processors and input suppliers. Substantial price discounts on inorganic fertilizers have been obtained by EWA in Senegal. Since there are few processors and many farmers, these cooperative organizations are important to give farmers market power. Market power facilitates the farmers in negotiating and developing practices to get all three types of gains from the marketing strategy.

In each country, some progressive processors are developing millet products. These progressive processors say that they are prepared to pay a premium price for higher-quality millet and sorghum grain. Priorities for the next production season are (1) getting the cereal threshing off the ground, and (2) higher-quality seed production.

Consumer demand for these high-quality millet products is expanding rapidly in Mali and Senegal. The export demand is also increasing but not as rapidly as domestic demand, according to the interviews. The generalized soil exhaustion and degradation make the combined use of organic and inorganic fertilizers critical over all of the region. This means that the markets for fertilizer, credit, and improved seeds need to be functioning well. Better seed has to be produced and threshing taken off the ground either with the "bache" (plastic sheets put on the ground) or threshing machines.

Many of the processors need to become better businessmen and less concerned with getting subsidies for machines or other technologies. Most processors have not well understood the importance of developing relationships with suppliers. The concept of contracts is just beginning to be understood and the processors need to invest more time with farmers to start building these ties (Table 9).

Product quality in general is being maintained at the processor level. That will continue to be important especially as processors compete for high-value, high-quality markets, such as for infant-weaning food. New product development, such as for the yogurt manufacturer in Senegal with "tchakri" (granulated millet with steam processing on the bottom), is expected to continue to be very important.

## Program priorities in Year 2

A review of what has been achieved in the first year of the program in comparison with the proposed program for Year 2 is presented in Tables 9 and 10.

Table 9. Summary of program weak points in the first year of operation

Weaknesses
1. Poor seed quality in Niger
2. No contract in Mali and only a verbal agreement of first purchasing rights in Senegal
3. Poor seed production systems in Niger and Burkina Faso
4. General soil exhaustion and degradation in the Sahel
5. Small-farmer organizations in Mali and Burkina, not large enough to have much bargaining power.
6. Inorganic fertilizers not always available in a timely fashion
7. Threshing on the ground in Mali and Burkina
8. Low grain prices at harvest
9. Contract concept not well understood
10. Business abilities of processors
11. New products development capacity

In Year 2 of the program, a plan will be developed for each region to improve the quality of seed production and to get threshing off the ground.

Program size will be increased from approximately 100 tons of cereals in each region to 350 tons. A price premium of approximately 10 CFA/kg for quality millet not threshed on the ground will be paid. Contracts will be signed by both sides.

There will be training for processors on developing relationships with suppliers, inventory control, and other principles of business management, including quality control and new product development.

A risk-insurance scheme with farmers paying a premium will be designed so that in bad-rainfall years, farmers are aided in repaying input costs and maintaining their incomes. This will be a self-financing program, not a subsidized program of the NGO.

An economic analysis will be undertaken in three countries (Senegal, Mali, and Niger) to estimate the gains in income resulting from each of the four strategies discussed. This fieldwork and write-up will be completed before the next planting period and will be used as an input into further project development (see Progress Report 1). Travel between countries of both processors and farmers will be facilitated by study trips of groups and regional planning workshops.

In this five-year project, a contract system will be implemented with NARS to respond to specific field problems with specific agricultural research as required in the field.

A workshop will be held with participating organizations including NGOs, processors, farmers, and donors. This workshop will review the accomplishments and limitations of the first two years of project operation and redefine the goals and mechanisms of Year 3. Travel between countries of both processors and farmers will be facilitated by study trips of groups and regional planning workshops.

Table 10. Activities accomplished during Year 1 and plans for Year 2 of the project

Year 1: Pilot activities in four Sahelian countries	Year 2: Continue project in Mali, Burkina Faso, Niger, and Senegal
<ul style="list-style-type: none"> <li>- Development partners are identified</li> <li>- Seed production from public agencies and farmer seed producers</li> <li>- Farmers' groups produce quality grain to supply processors</li> <li>- Contracts for approximately 100 tons of cereals negotiated in four Sahelian countries between farmers and processors</li> <li>- Estimate gains to farmers from contracts between farmers and processors</li> </ul>	<ul style="list-style-type: none"> <li>- Planning workshop to redefine objectives and activities with stakeholders including farmers, processors, and NGOs</li> <li>- Quality seed distributed to farmers' groups</li> <li>- Inventory credit suppliers identified and system operationalized</li> <li>- Training for farmers on market power and co-ops, inventory credit, quality grain production</li> <li>- Training for processors on quality and inventory control, new product development, relationships with suppliers</li> <li>- Information exchange between farmers and processors in the region</li> <li>- Development of a risk-insurance scheme</li> <li>- Establishment and implementation of a contract system for demand-driven agricultural research from the NARS to support this program at the farm level</li> </ul>

### Time frame

The project will last five years and will be launched in June 2004 after a regional workshop involving all actors involved in the millet and sorghum commodity chain.

## **Organizational arrangements**

- INTSORMIL will administer the program of the coordination unit and provide technical backstopping along with the NARS to agricultural problems as they emerge. This technical support will concentrate on marketing and food science. The scientists will perform the economic analysis of the program impact and potential of future impact.
- NARS' scientists will provide technical backstopping on production as problems emerge on contract and will participate in forums between farmers, processors, and NGOs. Research will provide quality seed of requested varieties and technical support to the farmers producing certified seed. The newly developed technologies will continually be introduced to the farmers.
- The national scientists and NGOs will implement research contracts between coordinating unit and NARS.
- The role of the NGOs will be to: (1) provide technical backstopping to farmers' organizations, (2) guarantee loans in the two years of the project for inventory credit. (3) arrange storage facility, (4) support in developing farmers' organizations, and (4) contribute to training farmers in producing quality grain and honoring contracts.

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# ***Food Processing and Marketing***

## *Concept Paper 2*

Lloyd Rooney, Bruce Hamaker, Botorou Ouendeba, and Ababacar N'Doye

### **Summary**

Excellent quality pearl millet processed products are being sold profitably by semi-industrial processors in Dakar, Senegal. Domestic and export demand are increasing faster than processors can expand their supply. The products range from millet flour to couscous to extruded snacks and yogurt containing millet couscous. The processors recognize the need to produce high-quality products and they are trying to improve their efficiency. Access to a consistent supply of millet with good quality, free of impurities is a critical factor along with the need to improve and expand production of processed foods to meet increasing demands. These are the exact areas that the four-country contract project is responding to.

Processing can be dramatically expanded by a carefully planned stimulus to promote production and delivery of high-quality grains to processors. Processors will be educated to pay more for the quality grains since it will improve their efficiency. For supply-chain management to work, the right mix of education and carefully targeted research demonstrations need to be put together.

A key component of success in Dakar has been the long-term efforts in millet-processing research and education by the Institut Technologie Alimentaire (ITA, Institute of Food Technology), which has been supported by numerous agencies including USAID. Finally, these efforts have paid off in tangible results. Another important factor has been the economic growth leading to increased demand for processed food products. With the rapid growth of food and food processing in Senegal, the stage is set for significant expansion of sorghum and millet utilization in the other Sahelian countries.

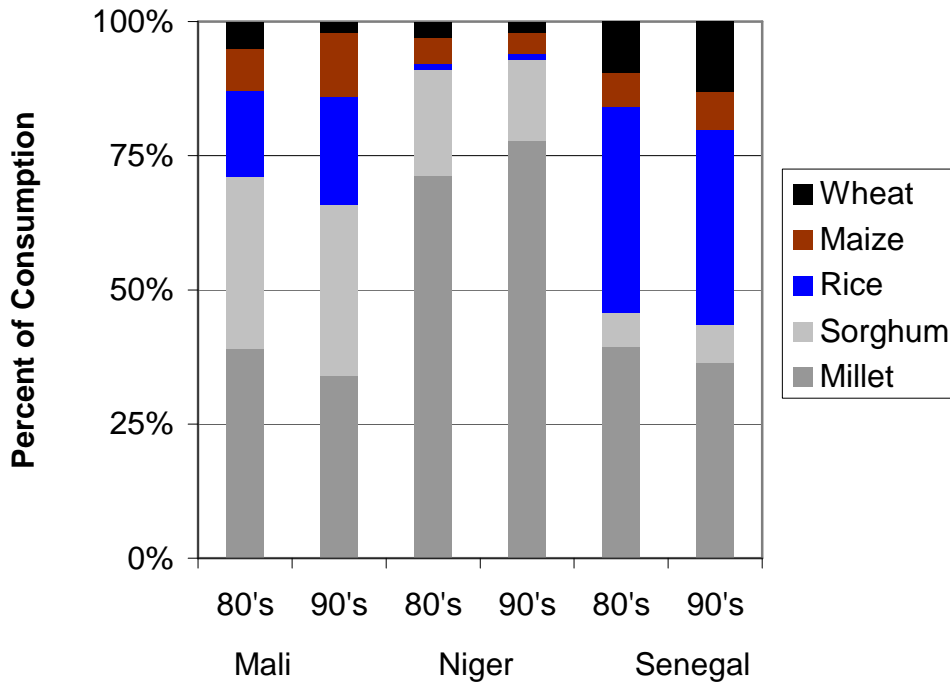
### **Introduction**

A four-man team of INTSORMIL (International Sorghum/Millet CRSP), ROCHAFREMI/ICRISAT (International Crop Research Institute for the Semi-Arid Tropics) and ITA scientists conducted an intensive 10-day evaluation of processors in Dakar. This report is based in part on this mission, but the team also has substantial experience in post-harvest technology of cereals, including sorghum- and millet-processing quality in Africa.

The first concept note covers production and marketing of value-added grains; this one focuses on delivery of high-quality grain to processors, enhancement of processing technologies, stimulation of entrepreneurial activity, and market development.

Millets and sorghum are the most important food crops in the Sahelian countries of Niger, Burkina Faso, Mali, and Senegal. There have been some gains in rice and wheat-based foods in urban areas in the last two decades but the predominant food grains of the Sahel remain

millet and sorghum (Fig. 6). The opportunity exists to produce foods from these local cereals for urban markets to satisfy urban consumers who demand food products that deliver convenience, taste, texture, color, and shelf-stability. Processors need to be able to charge prices sufficiently high to provide profits to farmers and to others in the supply chain, including themselves. High-quality domestic products often lead to exports and this is already occurring in the Sahel.



**Figure 6.** National cereal consumption patterns in three Sahelian countries  
 Source: Adapted from B. Coulibaly, B., 1999, pp. 13-16.

Profitable semi-industrial processors currently produce a range of products from millet for the Senegal and export markets that include millet flour, grits (*sankhal*), agglomerated products (*arraw*, *couscous*, *tchakri*), weaning food, extruded snacks, and a yogurt-millet product. This has happened over a period of 20 years through the efforts of the Senegalese government and a succession of donor-funded projects involving ITA in Dakar. Thus, the stage is set for other countries of the region to benefit from the experiences of Senegal.

A major obstacle to expanded production of urban foods is the lack of a consistent supply of grain that is clean and of good quality. Progress to develop improved-quality grains has been made but the delivery system to provide them to processors has been lacking. Commercial grain traders blend many different lots of grain and impurities are quite high. All of the processors in Senegal identified lack of sufficient clean grain as the greatest need. Thus, there is a need to bridge the gap between the producer and the processor.

The way to solve these problems is to use integrated schemes to increase profitability for the farmers and processors by value-added, supply-chain management. Research and extension programs are required to promote value-added, supply-chain management to deliver high-quality grain. Past figures of large donor-funded processing projects are in large due to poor linkages with producers and building large state-run processing facilities, which were not economically viable. The key is to link farmers to processors and markets in general and to expand urban markets by assisting small processors to grow by developing strong partnerships with research institutes.

Much needs to be done throughout the region to increase capacity of processors and concurrently to produce high-quality products that can expand markets. Examples of successful farmer-processor contracts and processing enterprises will serve as a model for others. The project is providing examples of other contracts, and the state of processing development in Senegal serves as a model for the other three Sahelian countries.

The framework described herein is sustainable because it is driven by consumer demand and depends on the value-added supply chain. The approaches outlined in these two concept notes represent a way to increase farmer's incomes and meet the long-range goal of reducing hunger in the region. The broad strategies required are to:

1. Provide supplies of clean, high-quality grain through contracts between producers and processors, to generate profits and enhance production and income.
2. Increase processing capacity and efficiency.
3. Develop business-management and marketing skills.

### **Value-added supply chain**

Excellent food products are being made from sorghum and millets; however, the lack of a consistent supply of good-quality grain for processing usually constrains a more rapid growth. The value-added supply chain includes:

1. Seed supplier (seed production) – quality and purity
2. Grain producer
3. Harvesting
4. Storage
5. Handling and transportation
6. Processing into products
7. Marketing

A consistent supply of good-quality grain at a price that allows the processor to make sufficient profit to share with all participants in the value-added supply chain is an important goal. This system requires identification of quality using simple objective procedures agreed upon by all parties. It is inherently difficult for producers and processors to understand each other's needs and problems. Communication is critically important.

A major limitation is the lack of high-quality grain in sufficient quantities for processing. More efficient methods of threshing and cleaning the grain to remove sand and other impurities are essential. Millets and sorghum grains in existing markets are extremely variable in kernel size, color, and cleanliness. In the fact-finding trip, the processors in Senegal indicated clearly that they want cleaner and less variable grain. In addition, some varieties and improved cultivars are available that will lead to significantly improved processed food quality. Thalack, a local millet variety in Senegal, has given excellent composite bread with increased loaf volume.

Methods to assess quality are required to facilitate supply-chain management. A set of standards along with practical specifications for each important quality criteria is required. These specifications must be agreeable and practical both to producers and processors. The cultivar of grain can be determined by mutual agreement. Environment will modify grain quality and this must be measurable. Communications among seed producers, production specialists, farmers and processors is required. Contracts are required along with grain-storage facilities to hold grain throughout the year and also inventory credit, as described in Concept Paper 1.

### *Current status of processing in the region*

## **SENEGAL**

As a part of the development of this concept paper, a team met in Dakar in January 2003 consisting of A. N'Doye, research director at ITA; B. Ouendeba, coordinator for ROCAREMI; L. Rooney, professor at Texas A&M University; and B. Hamaker, professor at Purdue University. The group visited key processors and related industries in Dakar to evaluate the current situation. Information on the leading Dakar processors is presented in Table 11. Interviews with processors visited clearly indicates that these processors are expanding their production and cannot keep up with market demand.

An USAID-funded project in the 1980s set the stage for production of high-quality millet products for the urban markets. Though concentrated on a large processing unit that was unsustainable due to lack of quality grain supply and market demand at the time, the project was effective in proposing future steps for the government and helped ITA to develop expertise. The subsequent IDRC-funded project successfully assisted small entrepreneurs to begin processing units using equipment developed or refined at ITA. Obtained equipment was paid back by processors into a fund for further research and development at ITA.

Table 11. Semi-industrial processing units visited in Dakar

Name	Year start	Products	Monthly production of processed products	Equipment	Market
Free work services	1994	sounghouf couscous sankhal arraw tchakri Infant food	12 MT	decorticators mills dryer granulator	domestic USA Europe
La Vivriere	1993	sankhal couscous arraw tchakri	24 MT	decorticator mill dryer mixer sieving	domestic USA Europe
AGC	1992	infant food sankhal arraw	10 MT	decorticator mill dryer mixer sifters	domestic
Traitement Fabrication de Produits Alimentaires	1997	sankhal flour for bakeries Arraw	24 MT	de-stoner mill decorticator	domestic
Yaourt Jaboot	1997 100 kg per day	yogurt with millets (tchakri)	3.5 MT tchakri (produces 120 MT yogurt product)	new production plant, decorticator, mills, sifters, steamers	domestic expansion to meet increasing demand; export to other countries in region
Profemu (women's cooperative)	1992	sankhal arraw tchakri couscous	25 MT	decorticator mill	domestic
SONIA Micro Doses Technologies		millets puffs 'CROC' (snack food)	15 MT	cleaner de-stoner decorticator mill extruders (2) automated packager	domestic

Afterwards, there was a targeted effort to assist local small family enterprises<sup>42</sup> where millet was processed into the traditional foods – flour (*soungouf*), grits (*sankhal*), and agglomerated products [*arraw* (agglomerated and dried), *couscous* (agglomerated, steam-cooked, dried)].

A recent EU-funded project (PPCL) enhanced the ability of processors to engage in the marketplace through advertising, business development, and linking processors to export markets. The millet network (ROCAFREMI) provided assistance to further refine processing technologies at ITA. EWA and ROCAFREMI initiated improved grain-quality acquisition through contracts with farmers. The current regional project, Sorghum and Millet Initiative, funded principally by IFAD and administered by Sasakawa Global 2000 in Bamako, is focusing on modification of equipment (enlargement of agglomerator, local fabrication of a mill to produce fine flours for bakeries, decorticator for continuous de-hulling), capacity-building, and technical support for the development of new products.

A rapid demand increase for processed products in urban areas in the past few years has enabled the expansion of several family-level businesses into semi-industrial enterprises. Most companies have expanded rapidly in the last three years. Two companies are increasing the value of millet nine to tenfold by producing high-value packaged products [snacks (SONIA) and yogurt with steamed millet (Yaourt Jaboot)]. These are both fast-growing companies with a more rapidly growing demand for their products in the Dakar market than they can meet. Thus, they are expanding rapidly and simultaneously improving the efficiency of their processing. They are aggressive and willing to pay for improved-quality grain.

The production of extruded snacks (SONIA) is an integrated operation that is self-sufficient. The packaging, drying, flavoring, extrusion, milling, and cleaning equipment were made locally or by the fabrication unit of the company (Micro Doses Technologies). The chocolate-flavored puffs are in packages of 30g sold for 50 FCFA to children. An inexpensive local packaging material works because the products are sold rapidly. The company's two extruders cannot keep up with demand in Dakar. A blend of millet (mainly), corn, and rice is used in a short barrel-extruder. The company is building a third extruder and is interested in expansion to other areas.

The yogurt processor (Yaourt Jaboot) is nearing completion of his second expansion after starting production in his home in 1997. The new facilities are impressive. The yogurt is of excellent quality; the processor is committed to securing high-quality millet and will pay for it. The cost of yogurt for consumers is significantly reduced compared to fruit yogurt. The processor uses advertising and has well-developed goals for expansion. The product is excellent and all members of the team were eager to consume more of it.

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<sup>42</sup> Successful processing enterprises have been aided in Dakar by ITA's work with entrepreneurs and in technology development. A succession of donor-funded projects [FAO, USAID, IDRC, PPCL/EU, ROCAFREMI (regional millet network), Sorghum and Millet Initiative (SMI)] has provided critical long-term support.

The rapid success of both producers of high-end products illustrates that sophisticated products, including locally grown grains, can be made profitably when the proper technical expertise and finances mesh.

The Senegal situation is ideal to demonstrate clearly the advantages of developing a value-added supply chain that links producers to the processors. Additional refinements in equipment will improve capacity and allow for improved quality control, packaging, sanitation, and labeling required for further expansion to sophisticated export markets. There is clear evidence that export demand exists, provided adequate high-quality products can be produced.

The respect of these processors for ITA contributions to their success was evident. The equipment, processes, technical assistance, and inspiration from ITA, based on its long-term experience in millet product research and development, is a key factor to the tremendous enthusiasm exhibited by these processors.

## **NIGER**

In Niger, the Niger Agricultural Research Institute (INRAN) food technology unit has a long-term relationship with INTSORMIL/Purdue scientists. In 1996, with assistance from INTSORMIL and the Niger InterCRSP project, a sorghum/millet entrepreneurial-scale processing unit was put in place consisting of a mixer, agglomerator (to process couscous and dégué), steamer, and solar dryer. Later, a commercial-scale decorticator, mill, and larger solar drier (with INTSORMIL support), and de-stoner (with ROCEFREMI support) were added to finish a complete entrepreneurial-scale cereal processing unit. The process was organized to produce high-quality agglomerated products to compete with imported couscous.

The INRAN/INTSORMIL co-developed sorghum hybrid, NAD-1, was principally used as a pure grain source for good product quality. Market testing was done on 5 MT of this NAD-1 product with highly encouraging results. Two large expositions were given that have generated substantial interest in the products and hybrid. Currently, INRAN food technologists are working closely with entrepreneurs with help from the Sorghum/Millet Initiative and INTSORMIL to develop a commercial market for the processed products.

## **BURKINA FASO**

The main millet-and-sorghum-processed products found in Burkina Faso are decorticated grains, flour, and drinks (beer-type) marketed in Ouagadougou. Decorticators and mills are widely used in small-family processing units. One entrepreneur, Ms. Zoundi, owns a semi-industrial processing unit equipped with appropriate machines to produce finished products (biscuits, cakes, and infant food).

For several years, local processors have received backstopping from CIRAD, ROCAFREMI and the national research institute through their food technology laboratory. The de-stoner developed by ROCAFREMI is currently being tested in Burkina Faso. A well-organized association of grain processors exists in Ouagadougou.

## **MALI**

The INTSORMIL CRSP initiated research in Mali in 1979 to identify the factors affecting the utilization quality of sorghum and millets. In the early 1980s, a food-technology laboratory was developed at the Institute of Rural Economics (IER). Equipment for processing and quality evaluation was provided, and several scientists were educated in the area of food technology. The laboratory provides inputs into the IER breeding programs in millet, sorghum, and other grain. Food-product development has been a continuing effort along with characterization of varieties for value-added properties.

The laboratory has provided assistance to many small processors and related users over the years. There is a modest amount of equipment to develop and evaluate food products as well as quality assessment. There is a need for more trained personnel and selected equipment for processing.

Several prototype products developed in the IER Food Technology Lab — including a millet-cowpea weaning food, decorticated, parboiled rice-like products and composite flours — were produced on a small-scale industrial basis. These attempts failed mainly because of the lack of a consistent source of clean grain with uniform size and color, and free of offensive odors, sand, and other impurities. A medium-size dry milling operation for maize and sorghum failed for the same reasons. Yet small artisans (housewives) continue to make money by selling high-quality maize meal, flour, and grits in the Bamako area. They have access to a supply of good-quality maize.

Early in the program, the goal was to improve the yield and quality of sorghums by introducing an earlier-maturing, white/tan plant sorghum. However, this variety was susceptible to head bugs and mold and could not be processed into traditional food products. N'Tememissa, a photosensitive variety that avoids head bug and molds, was released. It demonstrated excellent processing properties and has been identity-preserved, stored, handled, and processed for composite flours, decorticated rice-like products, and sold as a clean food type of sorghum on a limited basis in Mali. The proof of principle has been demonstrated. The improved quality was appreciated by consumers who bought the products and even the clean white sorghum.

### **Lessons learned – summary of what we know**

The stage is set to build on the strengths and the experience gained from recent successes. The need for value-added, supply-chain management as described in this document should result in expanded markets for these grains that can generate profitability along the supply

chain. The process is evolutionary and will require assistance from many sources over time. Several key observations follow:

### **More on quality**

- There is a need to create a value-added chain where everyone benefits and to foster collaboration among farmers, processors, and developers of new varieties throughout the value-added chain.
- Most NARS have crop improvement programs that are actively working with food technologists to identify and improve end-use quality of major crops.
- Quality is a central focus of the most successful processors in Dakar. High-quality grain is lacking. Most but not all processors expect to pay for improved quality grain. They need to be shown how much increased profit can result from increased grain supply and quality management.
- Assistance is required to develop standards that are practical for grain and end products. This will become important in defining quality grain.
- Processors lack facilities to store and manage grain. Contracting with cooperatives has been initiated and must evolve. These cooperatives have become involved in cleaning and storage.

### **Food processing**

- In Senegal, thriving businesses have developed that are several steps above the original micro-enterprises. These businesses have generated income and provide employment mainly to women. Urban markets for millets/sorghum-based products are expanding rapidly.
- Large-scale processing (high-capacity, modern production of sorghum and millets) has not worked in the past and will not work today. This has been shown for most African countries. Many examples of failures exist in Senegal, Mali, Niger, and other countries.
- Associations of processors comprised primarily of women are improving processes and quality. They recognize the need to secure better sources of quality grain.
- The long-term encouragement and technical support provided by ITA was and is critically important for success, as in Senegal. Effective relationships with research institutions are necessary to support the industry.
- Outside of Senegal (in Niger, Burkina Faso, Mali), the current level of commercial millet and sorghum-processing is quite low. Additionally, the buying power of urban consumers

is less than in Dakar and other urban centers in Senegal. However, sizable consumer markets exist for convenient processed foods that undercut more costly imported foods or appeal to traditional tastes. A range of products of type and price should attract even lower-income buyers. Lastly, though poor, countries of the region are currently experiencing growth that should translate as more consumers are able and want to buy easy-to-prepare processed foods from millets and sorghum.

### **Technology transfer**

- Techniques and equipment developed in Senegal are appropriate for the region and should be helpful to other countries. ITA in Senegal is a far more advanced institute in food science than is available in the other Sahelian countries. IITA has extensive trained staff and processing laboratories. ITA has facilitated a more rapid development among the food processors.
- Equipment is generally available for small-scale processing, but more technical assistance is required to assist entrepreneurs to develop prototype products. This is especially true for upscale products, i.e., snacks, breakfast cereals, and ready-to-eat porridges.
- Financing for equipment and infrastructure is required but should not be a handout. The successful businesses in Senegal started very small and expanded as profits and demand allowed.
- Business-management training was a significant input for Dakar processors for expansion and successful evolution of their enterprises. Workshops, practical training, and interactions facilitate growth.
- Advertising and promotion were important to increase sales in the Dakar market. Substantial activities in this sector were undertaken as a part of the EU-funded PPCL project to educate consumers on positive aspects of millet products.
- More NGOs with food-technology expertise are needed to educate all phases of the emerging food-processing industries.
- Product market predictions cannot always anticipate market growth. For example, the US tortilla industry today is a multibillion-dollar industry. Less than 40 years ago it was a cottage industry initiated by Mexican immigrants. These immigrants cooked corn in the garage in a #10 wash tub with hand-processing and packaging for sale in the immediate vicinity. In a few years, a number of these enterprises grew into million-dollar operations.

## Grain supply, processing, and marketing strategies

The cornerstone of this concept note is to use value-added, supply-chain management principles to provide a consistent supply of clean, high-quality grain for production of good-quality processed products ranging from flour and grits to sophisticated snacks and ready-to-eat items. Strong linkages will be established between farmers' associations and processor groups to produce and deliver increased quantity and quality grain to the processors. In turn, the processors will generate sufficient increased profits to pay farmers higher prices. The increased incomes and expanded markets developed by processors will allow them to finance better equipment and improve processing practices that will permit export market expansion.<sup>43</sup>

Critical to the contracting activities proposed between farmers and processors is the realization that processors must be assisted to expand markets for quality millet and sorghum products. Contracts leading to increased farmer profits will work only with a healthy and growing market for their grains. Successful models of processors marketing consistent high-quality products include the yogurt and extruded products in Senegal.

An important lesson learned in Senegal was that processors became successful because they (1) had access to appropriate, modern processing technologies, and (2) were constantly backstopped by ITA. Entrepreneurs started small in nearly every case, but their ability to successfully expand depended on these two inputs. The initial barrier of obtaining basic equipment was usually facilitated through ITA with a payback scheme incorporated into the loan. Throughout the region, a similar approach is likely to be initially needed. Later, successful businesses will be able to expand and new start-ups will be more forthcoming, as has been the case in Dakar.

A modest strategy to assist processors and expand markets could include:

- A strengthening of NARS food-technology laboratories with additional basic pieces of processing equipment and training/backstopping. Probably this would include an agglomerator for Mali and Burkina, a dryer for Niger, and a decorticator for Burkina Faso.
- Assisting a few entrepreneurs in each of the countries to set up basic processing businesses.
- Ensuring close working relationships between NARS' scientists and processors for processing competitive, quality products.

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<sup>43</sup> Another view is that the processors will need more active involvement in getting equipment. Modest amounts (only one to two per country) of key new technology, entrepreneurial-scale processing equipment (i.e., mechanized agglomerator and dryer) could be provided on a revolving (payback) basis to a few entrepreneurs whose enterprises act as models for others. This is not to be designed as a scheme to give equipment to private businessmen but contrarily to get these new technologies out to the commercial sector and to prime-the-pump for successful commercial enterprises.

These activities will stimulate an expansion of processing of millet and sorghum products in the region, as is already occurring in Senegal.

### **Quality grain supply**

A strategy to obtain quality grain for processors is:

- Cleaning
  - Implement grain-cleaning machines at both the producer/cooperative and processor levels.
  - Training in the region for processors to take on certain cleaning practices to obtain quality products.
  - Work with processors and suppliers to obtain objective data on the increased profitability and consistency obtained by a clean grain sample.
  - Conduct a test run of a contract system to provide a quality grain supply to the processor. Let each player in the supply chain determine the benefit of such a system.
- Standards
  - Refinement and implementation of consistent grain and end-product standard. Tests will be uniform in the region, but application will differ within the region.
  - Simple standards objectively applied will be implemented for effective communication among participants in the supply chain.
- New varieties
  - Select varieties that have documented processing improvements for specific products increase them through farmer's cooperatives and plan-test with specific processors. The economic analysis will be made to assess the profits.
  - Characterization of new cultivars being developed in NARS' or IARC's breeding programs for value-added production and processing.
  - Adoption of new varieties from breeding programs. This is a way to get improved varieties to market (e.g., Thialak in Senegal, NAD-1 sorghum hybrid in Niger).
  - Increasing processing capacity and technology.
  - Where specific quality varieties are needed, contracts will be developed to accommodate processors for varietal specification.

- Effective communication of grain attributes and importance of increased grain yields in terms of profitable products per hectare will be needed.

### *Increasing processing capacity*

A modest strategy to increase processing activities is:

- Improving the ability of NARS food-technology units to assist entrepreneurs.
  - Complete entrepreneurial-scale processing units for each country NARS. All currently have at least some grain processing equipment. Niger, for example, now has a complete unit for processing high quality flour, grits, and agglomerated products. This unit is successfully being used to demonstrate and train entrepreneurs and has been used to optimize processes and products as well as for product market-testing. Processes are ready to be transferred to the private sector. A good, basic processing unit, as found in Niger, should have the following equipment items:

Grain cleaner and de-stoner

Decorticator (de-huller) and flour/grit mill

Agglomerator

Steamer

Dryer (ideally the newly designed dryer being developed by ITA)

Low-cost packaging machine

An additional consideration for all four countries would be a small, low-cost extruder to process simple snack products.

### **Development of human capital in the processing industry**

- ITA/Senegal, with its history of appropriate equipment development, should be viewed as a center to provide leadership for equipment acquisition and refinement. Experience in prototype development of the dryer and agglomerator can be utilized in the other Sahelian countries.
- Assist a few entrepreneurs in each country to develop competitive processing businesses with potential to expand. This could include:
  - Identifying two to three entrepreneurs in Niger, Burkina Faso, and Mali, preferably with experience in cereal processing and some technical know-how, to start or

expand existing small-scale commercial processing units.<sup>44</sup> In Senegal, the focus will be on expanding capacity to meet growing market demand.

- Training of entrepreneurs in processing methods at NARS food technology units. Entrepreneurs will then have limited access to the unit to process products and market them.
- Create a mechanism whereby the few entrepreneurs identified above can obtain equipment (primary items followed later by more sophisticated items if warranted). One idea is through credit-lines (from donor) with a payback system that is used to support NARS research/extension on processing. This system was effectively used in the IDRC/ITA project in Senegal. Or the payback system could be used to support the purchase of other pieces of equipment for existing or new processors. This system was used by the ROCAFREMI regional project on millet processing.
- Continue existing work through processor associations to support and assure the commercial processing of high quality, competitive millet and sorghum products.
- NARS units will have an additional role of solving technical problems by contract through the project, as well as continual refinement of processes and new product development.

### *Business and market development*

Following initial training of processors and setting up of commercial units, there will be an implementation of business and marketing training of entrepreneurs. These activities were important to the growth of millet-based products in the Dakar market and development of effectively run businesses. A strategy will be to:

- Advertise in the print and television media the benefits of buying locally-produced sorghum and millet-based products in terms of their high quality, convenience, and healthfulness.
- Conduct training seminars or workshops, mainly at the local level but also at the regional level, on topics that will improve business profitability and product quality and marketability. Both domestic and export markets should be considered. Examples of topics are bookkeeping/accounting, sales and distribution, quality management, sanitation, export market regulations, fortification, and packaging/labeling.

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<sup>44</sup> Another proposal to be discussed is the local fabrication of three to five mechanized agglomerators (approximately \$7,000 each), and perhaps the ITA-designed dryer.

### *Additional considerations*

- Systematic exchange of information within and among countries is critical.
- Coordination and collaboration with other existing donor-funded related projects especially the Sorghum-Millet Initiative.<sup>45</sup>
- Increased value of processed by-products for the animal feed industry needs to be pursued.
  - Nutritional analysis of bran and other waste streams.
  - Increase value of by-products (e.g., bran).
  - Coordination of processors with the animal feed industry to sell by-products.
- Advisory and technical backstopping.

### **Conclusions**

*The stage is set for significant expansion of food and feed utilization of sorghum and millets in West Africa.* The technologies exist to allow for rapid production of food and feed products with sufficient value to allow for profits for the entire supply chain. New products from improved quality sorghum and millets can compete with existing foods because of new processes and improved management skills.

The need for contracts, credits, management of storage systems along with an understanding of storage costs and related problems is necessary for progress. Senegal is serving as a useful model of what can be done in the Sahel. It is important that Senegal farmers benefit more from this rapid growth of processors as they are increasing the supply of quality grains.

Some limited funding will be required to provide equipment to the NARS in each country to enable them to have adequate pieces of equipment that would allow food processors and potential food processors to develop prototype products. This would vary among the four countries but would be limited to critically needed equipment to complete their capabilities. The sorghum and millet initiative has provided some useful equipment so it is anticipated that the needs would be relatively small. The project should assist potential processors to use pilot-scale equipment in the respective national laboratories and help them to obtain financing for specific equipment needs.<sup>46</sup>

The major requirements will be for training and education of personnel to interact with ITA to obtain information relative to processing equipment and technologies that can be adapted to local conditions. This will enable national laboratories to provide assistance in processing and related activities.

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<sup>45</sup> Presently programmed to last through 2004.

<sup>46</sup> This approach also avoids the persistent problem in developing countries of turning would-be entrepreneurs into perennial searchers for subsidized inputs, who then feel little pressure to become more efficient and cost-conscious producers.

New upscale products and feeds rely on a consistent supply of reasonably good-quality grain at competitive prices. Thus, high-quality sorghum and millet food products that compete with the convenience, taste, texture, color and acceptance of foods from wheat, maize, and rice need to be available at affordable prices. Grains from the existing market channels cannot be used to produce profitable high-quality foods on a consistent basis. Contracting is necessary to obtain adequate supplies of quality grain. This is especially true for sorghum.

The management of grain-supply chains is necessary to allow profits for all participants and is a way to deliver new cultivars and technologies to producers so they can service markets that are reliable and profitable. Management of supply chains is difficult but progress is happening across West Africa, especially in Senegal, where many processors have developed profitable products and are more willing to pay for improved-quality grain for processing.

The challenge ahead is to promote and expand the necessary organization and structure to develop systems of seed and grain production, harvesting, handling, and storage that utilize the new improved varieties to provide profits for all along the supply chain. The pieces of the puzzle are now available. The next essential step is to assemble the complete supply-chain management system.

This requires expanded education and knowledge of market standards, contracts, and strong interactions among the components of the system. The challenge is great but progress is occurring in West Africa, Central America, and other places. The development of new cultivars is critically important to improve the quality of the grain.<sup>47</sup>

Feed utilization is a necessary component of the system. Feed mixers can utilize lower-quality grains that cannot be used in food products and will absorb additional production beyond local food demands. Chickens cannot be fed without a consistent supply of grain all year. The same is true for food products that must be available at all times of the year.

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<sup>47</sup> The partially photosensitive variety N'Tenemissa and its derivatives in Mali have enhanced quality and can enable farmers to supply markets in urban areas because of its superior quality.