



# **Transfer of Sorghum, Millet Production, Processing and Marketing Technologies in Mali**

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**Annual Report  
September 29, 2007 – September 30, 2008**

**USAID/EGAT/AG/ATGO/Mali  
Cooperative Agreement # 688-A-00-007-00043-00**

**Submitted to the USAID Mission, Mali**

**by**

**Management Entity  
Sorghum, Millet and Other Grains Collaborative Research  
Support Program (INTSORMIL CRSP)  
Leader with Associates Award: EPP-A-00-06-00016-00**



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# Transfer of Sorghum and Millet Production, Processing and Marketing Technologies in Mali

## Introduction

This report details the recent progress achieved under the Cooperative Agreement # 688-A-00-007-00043-00. The report covers progress in the **Production-Marketing, Food Processing and Décrue Sorghum** components and summarizes the **Production – Marketing Workshop** held August 12-14, 2008, Hotel Plaza, Bamako, Mali and presents a portion of a **proposal** which was submitted September 23, 2008 in response to an RFA dated August 26, 2008 from the USAID Acquisition and Assistance Office, Bamako, Mali for a modification of Cooperative Agreement #: 688-A-00-07-00043-00.

Mpoko Bokanga, Executive Director of AATF speaking at the African Green Revolution Conference in Oslo aptly expressed the problem of moving agricultural technologies onto African farmers' fields (see box below). In response to such comments we have designed this project specifically to move sorghum and millet production technologies onto farmers' fields, link farmers' organizations to food and feed processors and to commercialize processing technologies so as to enhance markets. To achieve this we improve the supply chain from the farm level to the consumer.

*"The continuing puzzle for us is that the adaptation of these technologies is very limited. We cannot see yield improvement in our countries."*

**Mpoko Bokanga, Executive Director,  
African Agricultural Technology  
Foundation (AATF) at the African Green  
Revolution Conference in Oslo, August  
2008.**

### Objectives

- Facilitate adoption of production and marketing technologies to improve the productivity of sorghum and millet in targeted areas and increase the incomes of farmers
  - Introduce micro fertilization strategies and associated agronomic improvements into the décrue farming systems in the northern regions
  - Introduce strategies to counter output price collapses to farmers' groups while linking them to food and feed processors where they exist
  - Develop stronger farmers' groups and enhance farmers' groups marketing power
  - Assist in producing a cleaner supply of millet and sorghum and assisting farmers in getting paid a quality premium for the higher quality product
- Facilitate the development of markets for food use for millet and sorghum and as a poultry feed for sorghum
  - Extend select mechanized processing technologies to entrepreneurs and processor groups
  - Upscale the seed sector at project sites

## Objectives, targets and benchmarks/indicators Yr 1-3

Targets and benchmarks/indicators will be used for evaluation and measuring economic impact over a three year period

Objective 1	Targets	Benchmarks/ indicators
Network establishment to enhance partnership development with relevant stakeholders	Increased joint programs with partners	- Networks established involving all relevant stakeholders (private industry, NGOs, farmers associations, national programs, international agencies, research and technology transfer agencies)
<b>Achievements Yr 1:</b> 1.		

Objective 2	Targets	Benchmarks/ indicators
To increase the incomes of farmers by introducing better marketing strategies combined with new technologies.	Increased yields and incomes	- 50-100% increase in rural income of targeted population - 500 ha increase in production area - Farmer acceptance of new technologies - 30-50% increase in grain prices
<b>Achievements Yr 1:</b> 1.		

Objective 3	Targets	Benchmarks/ indicators
To improve the efficiency of input markets for millet and sorghum in Mali	Decreased costs of inputs to farmers	- Trade and business associations and community based organizations assisted - 50-100% increase in rural income of targeted population
<b>Achievements Yr 1:</b> 1.		

Objective 4	Targets	Benchmarks/ indicators
Developing alternative markets for sorghum and millet grain	Increased demand for sorghum and millet grain	<ul style="list-style-type: none"> <li>- 2 new processing technologies made available for transfer</li> <li>- 100% increase in number of entrepreneurs utilizing sorghum and millet for food and feed products</li> </ul>
<b>Achievements Yr 1:</b>		

Objective 5	Targets	Benchmarks/ indicators
Develop sorghum and millet production technology for the “culture de décrue” system and moto pump irrigation system using the farmer participatory approach	Increased yields and incomes	<ul style="list-style-type: none"> <li>- 3 new management practices made available for transfer</li> <li>- All hectares of natural resources (sorghum and millet landscape/watershed) at target sites showing improved bio-physical conditions</li> <li>- 50-100% increased in farmer incomes</li> <li>- 500 ha increase in area under improved technologies</li> <li>- Farmer acceptance of new or improved technologies and cultivars</li> </ul>
<b>Achievements Yr 1:</b>		

Objective 6	Targets	Benchmarks/ indicators
Upscaling the sorghum and millet seed production industry in collaboration with other agencies	Increased availability of seed of improved sorghum and millet cultivars	<ul style="list-style-type: none"> <li>- Individuals at each site receive training in seed production and marketing</li> <li>- 50-100% increase in yields</li> <li>- 50-100% increase in farmer incomes</li> <li>- 500 ha increase in production area</li> <li>- Farmer acceptance of new or improved technologies and cultivars</li> </ul>
<b>Achievements Yr 1:</b>		

Objective 7	Targets	Benchmarks/ indicators
Communications/ publications	Increased awareness by entrepreneurs of opportunities for use of sorghum and millet in the food processing and poultry feed industries	<ul style="list-style-type: none"> <li>- Increased demand for sorghum and millet grains</li> <li>- 50-100% increased in farmer incomes</li> <li>- 100% increase in number of entrepreneurs utilizing sorghum and millet for food and feed products</li> </ul>
<b>Achievements Yr 1:</b>		

***Production - Marketing***  
***Dr. John Sanders***

*1<sup>st</sup> ¼ report in blue font*

*The **production to marketing** activities are led by John Sanders (Purdue University) and Botorou Ouendeba (Consultant/Niger). The team is implementing a system including technology introduction, development of farmer groups, marketing strategy innovation, and linking of farmer groups to food and feed processors. This system is functioning well in southern Mali and activities there will be continued and expanded. But the main thrust is to move the project further north into decrue sorghum regions and into more marginal millet regions.*

*This activity draws on the expertise of INTSORMIL scientists in its technology development, extension and marketing activities. Activities are conducted in collaboration with the main agricultural research agency in Mali, the IER (Gao-based scientists in the north), the AEG (Ministry of Agriculture and Extension), local NGOs in Koutiala and Tingoni and various extension-development organizations, various farmer associations, millet processors and intensive poultry producers.*

*In March, Ouendeba, Diourte, Toure, and Sanders spent several weeks visiting sites and talking to farmers' associations. In the summer of 2008 we will have approximately 500 ha in new technologies. In Kafara, Dioila, Koutiala, and Kolokani there will be 350 ha in sorghum. Then there are 150 ha in millet in Tingoni. The funds have been sent to Mali and Diourte of IER has been sending them out to the different farmers' associations and helping them buy the fertilizer.*

*We will again be visiting in July to see that all the money and inputs have been successfully received and to identify any problems. Note that only with area extension are there funds provided except for monitoring. In much of this area inputs and other expenses are paid by the rotating fund operated by the farmers' associations.*

*We also visited Mopti in March and arranged our activity schedule with the various government agencies and we will go back in July to see the designated region and to talk to farmers there. The suggested region is about two hours from Mopti. We are therefore well advanced in the process of getting our technologies and marketing strategies into the northern regions where there are more expensive inputs and greater distances to major markets.*

*August 12-14, 2008 we will hold a workshop for millet and sorghum food processors and farmers' associations and others working in this subject area in the West Africa Region. This international workshop to be held in Bamako has four objectives:*

- 1) To indicate the importance of paying a price premium for clean grain and for the farmers to receive some of the benefits from the seasonal price increase. Clearly the processors need a supply of grain at harvest as well as throughout the year. Thus, grain sales need to be spaced throughout the year. If the processor wants to buy all the grain at harvest, then the farmers' associations should be paid a seasonal (as well as a quality) premium as if sales were spaced during the year.*
- 2) To demonstrate the cleanliness of the grain threshed on the tarps, and if there are problems (as farmers' associations purchasing cheap tarps which develop holes when run over in the threshing process), to identify the problems and make modifications to the "bache" strategy;*
- 3) To convince processors that there is potential to substitute sorghum for millet because we can increase sorghum yields much more than millet yields and because we are already doing well in linking millet processors with farmers' associations in Tingoni, Mali and Thiare, Senegal. Moreover, Lloyd Rooney will report on his experience in Japan where he has been encouraging processors to use more sorghum products and where there is now an important processing sector.*
- 4) To build the contacts between the millet food processors and the INTSORMIL and IER food scientists. The Sahelian food processors often accuse us of doing too much for the farmers' associations and not enough for them. So we believe that these stronger relationships with food scientists will help consolidate the relationships between the farmers' associations and the Mali food processors.*

*Annually we evaluate and publish our results and innovations as well as documenting the problems encountered. We have produced a bulletin analyzing processors' difficulties in obtaining quality grain and estimating the price they can pay for clean grain. One of the objectives of the above workshop is to disseminate and discuss the results of this bulletin (Aminata et al, 2007). A second bulletin will be released shortly, in this year of the Mali project, analyzing the yield and income results for an earlier year of the project, 2006. There is a lag in getting these bulletins out because we have to wait for the yield data. However, it is important to report both on increasing yields and implementation of the marketing strategy. One of the key components of the marketing strategy is to encourage the farmers' associations and the farmers to sell their grain significantly after the post harvest price collapse. Thus we need to wait until 6 to 8 months after harvest. This second bulletin, which describes the best farmers getting 2 to 3 tons of sorghum and 2 tons of millet and the average increase in farmers' yields in most regions being 50 to 100% while obtaining 20% higher prices, validates the Production to Marketing activities.*

*Of the five marketing strategies we have been most successful with the first two of getting the farmers' associations to sell later and using the "bache" (tarps) to produce a cleaner product plus encouraging the processors to pay a quality premium. A third marketing strategy component is to develop new markets to moderate the good weather price collapse. Besides working with the intensive poultry industry on this marketing strategy this workshop should help to build closer ties between the food scientists and the food processors. This bulletin will first be published in English (Abdoulaye et al, 2008, forthcoming) and then in French.*

*References:*

*Aminata Toure, Tahirou Abdoulaye, John H. Sanders, and Botorou Ouendeba, Transformation Commercial du Mil et du Sorgho au Mali, Projet Production-Marketing, INTSORMIL Bulletin No. 7, Purdue University, West Lafayette, IN , 47906, November 2007.*

*Tahirou Abdoulaye, John H. Sanders, and Botorou Ouendeba, Evaluation of Sorghum and Millet Technology and Marketing Strategy Introduction: 2006-07, Production-Marketing Project, INTSORMIL Bulletin No 8, Purdue University, West Lafayette, IN , 47906, forthcoming June 2008.*

### **Present Status of the Production-Marketing Program**

In the summer of 2008 there were 1,165 ha in new technologies of sorghum and millet and approximately that many farmers in Niger, Senegal, and Mali. We are now concentrated in Mali with 500 ha (see table). We will be further expanding our program in Mali during the next five years. In 2009 we will approximately double our Mali program and initiate activities in the north, the Mopti region for both sorghum and millet. The planned activities will be discussed in the next section after first reviewing present activities, the progress to date, and those activities for which more attention is needed.

**Area (ha) in new technology in the Mali INTSORMIL Production-Marketing Project in 2008 and planned area for 2009.**

<b>Crop</b>	<b>2008</b>	<b>2009</b>	<b>Site</b>
Sorghum	100	150	Kafara
Sorghum	100	150	Diola
Sorghum	100	150	Koutiala
Sorghum	50	100	Kolokani
Millet	150	250	Tingoni
Millet	-	50	Bengass (Mopti region)
Sorghum	-	50	Douentza(Mopti region)
<b>Total</b>	<b>500 ha</b>	<b>900 ha</b>	

Source: 2008 areas provided by Botorou Ouendeba from the reports of the national research and extension agencies collaborating with the INTSORMIL Production-Marketing Project. Plans for 2009 are tentative until worked out with the local farmers' associations

This project starts with the farmers getting technologies onto their fields. The new technologies include new cultivars, moderate levels of inorganic fertilizers, water harvesting techniques, and other agronomic improvements. IER and NGOs, such as Global 2000 and AMEDD, work with us in the delivery of the technologies and the monitoring of the farmers. The seeds and fertilizer are paid for by the Production-Marketing Program and provided as input credits to farmers. Another critical input provided is the tarps (see photo) to get the threshing off the ground and thereby produce cleaner grain for the processors. The input credits for the seed and the inorganic fertilizers must then be repaid to the farmers' association in grain at harvest. The farmers' association makes a profit from the cleaner grain and the higher prices from selling later in the year. With the credit repayment and the profits from cleaner grain and better marketing the farmers' association then has a rotating fund for input purchase, expansion of membership, and inventory credit. Simultaneously we also regionally test new cultivars from the national breeders in this process. Once the new cultivar has been introduced in the first year of the program we work with local farmers and the farmers' organization to produce seed for succeeding years in the region. This requires training local farmers in the principles of isolation and roguing. Roguing is an especially difficult concept because the new cultivars are generally of medium height and farmers traditionally select the taller, hardier cultivars. Once farmers understand the concept of selecting for less stalk and more grain, this process works fine.

## Fundamental concepts of technology introduction

Water and soil fertility are the principal agronomic constraints and need to be simultaneously addressed. Low input strategies do not work given the serious soil fertility deficits. To pay for the additional expenses from quality seeds and moderate levels of inorganic fertilizers we introduce a series of marketing strategies. These strategies increase the expected prices for farmers.

### The Marketing Strategies Employed

- 1) **Avoid the post harvest price collapse.** This is a chronic problem as low income farmers need money for a series of expenditures at harvest. The farmers' associations sell later after the price recovery. The farmers often need Inventory Credit (warrantage). The farmers' associations are already using local storage, controlling storage insects and selling the grain reimbursed by farmers. The next step is for the farmers' association to gain sufficient confidence from farmers so that they will allow the association to sell more of their grain.
- 2) **Produce clean grain and get a price premium for it.** Malian food processors estimate that they receive an average of 13% impurities in the millet they purchase. By having farmers do the threshing on tarps ("bache") and produce only one cultivar, selected by processors, we remove the main sources of contamination and uneven grain type. Then the farmers' associations need to press the processors to pay a premium for a higher quality product. Processors are happy to pay their opportunity costs, the costs to hire a woman to clean the grain (10 CFA/kg). But they have been resisting paying for the additional 13% of the grain available once the impurities are removed. We held a workshop of millet/sorghum food processors and farmer representatives in the summer of 2008 partially to overcome this resistance to paying for the added value of the clean seed.



**Farmers threshing sorghum on a tarp in Tingoni Mali. Photo courtesy of Sandina Camera, SG, 2000.**

- 3) **Purchase inputs and sell the grain through the farmers' associations.** These farmers' associations by buying and selling in quantity are able to get better prices from bulk operations. They also can invest more in market information than the individual farmers. Thus, they give farmers increased bargaining power both in buying inputs and selling the grain.
- 4) **Provide technical services** to food processors (millet) and intensive poultry producers (sorghum) to facilitate *demand expansion* in these sectors through new products and/or reduced production costs. This demand expansion is a response to the problem of the good weather year price collapse. The Production-Marketing Program involves both food scientists and livestock nutrition specialists to engage with the food/feed processors. Other techniques to expand demand are to improve inter-regional and international grain sales.
- 5) **Convince national policy makers to reduce their intervention in bad weather years when the cereal prices increase.** The donors and the World Bank are largely taking care of this. It is important to distinguish between a bad weather year and a disaster year. In the latter, as when cereal prices are higher than 220 FCFA, governments need to intervene

with disaster relief. However, the intervention technique is important for agricultural development.

## **Progress on Objectives to date**

We have been most successful in achieving the four objectives of diffusing the agricultural technologies, organizing local seed production, introducing new marketing strategies, and developing the farmers' organizations. The farmers' organizations have been storing the grain which provides them with input credits as outlined in the first three marketing strategies above. The farmers' organizations have been acquiring identities as successful economic units. They buy inputs, store and sell the grain. Repayment rates for the inputs have been very high, generally over 95%. In Senegal, the Thiare farmers' organization has good ties to the Dakar millet food processors and has recently borrowed money from the bank in which they have their account.

The next major objective for the Production-Marketing Program is for the farmers' associations to handle most of the surplus grain for sale after the home consumption of the members has been satisfied. To do this the farmers will often need inventory credit as well as confidence that the farmers' associations will share the profits of the late sales with the farmers. As these farmers associations reach approximately 150 ha and members we will be training them in business and cooperative management as well as continuing our training efforts in technology and marketing activities. We are presently at this stage in Tingoni, Mali with 100 millet producers and 150 ha of millet. We began our training activities in the summer of 2008 and will ultimately contract with NGOs to develop modules in the local languages for this training.

*On developing the ties between the farmers' organizations and the food/feed processors:* We have promoted contracts in the past. In the absence of a tradition of contracts and contract law, either the processors or the farmers' organization reneges on the contract depending upon whether the price is higher or lower in the market than the contract price. So we have concentrated on convincing processors of the importance of paying for increased quality and on building up the bargaining power of the farmers' organizations to negotiate a better price especially demanding a payment for the reduction of trash in the millet and selling the grain later after the recovery from the post harvest price collapse. The complaint of the processors is that we are just making their costs higher. So we are tightening our connections to INTSORMIL and IER food scientists and the INTSORMIL poultry nutrition specialist and facilitating their work with food and feed processors in developing new products and reducing the production costs of the food and feed processing sectors through increased efficiency rather than squeezing their suppliers, the farmers.

There are two major markets that we are concerned with and there are different strategies for the different markets. For food processing, millet is preferred by Sahelian processors for taste reasons. There could be some substitution of sorghum and we are encouraging this because it is easier to get sorghum yields up than those of millet. For this food market we need a very clean grain and potential to regularly supply and negotiate with processors. Processors need the grain throughout the year. We are teaching the farmers' associations to sell as much as possible after the post harvest price collapse. Some interaction and compromise is necessary between the two sides. But with the increased bargaining power of the farmers' association they should be able to drive harder bargains and still satisfy the processors with the regular supply of a cleaner product.

The other major market and the principal new market for sorghum is for poultry feed. Sorghum has approximately 97% of the feed value of maize as long as it is a no tannin cultivar. There are many non- tannin cultivars available in the Sahel. Sorghum has to be competitive with maize in yields so that the price is less than 97% of the maize price. Sorghum also has an advantage over much of the maize sold in the Sahel from the high rainfall coastal countries because sorghum, in contrast to maize, does not get the fungus producing aflatoxin while in the field.

The cleanliness factor is less important with poultry feed than for food processing. We have made much more progress building the ties and producing the clean grain for food processors than supplying sorghum for intensive chicken feed. We have done some surveying and produced two bulletins, one on the tannin levels in sorghum and the other on the intensive chicken production in Senegal. In 2009 we will be producing a bulletin on the intensive chicken industry in Mali and how to facilitate its growth with the availability of low cost sorghum.

It should be noted that by both increasing yields and decreasing the cost of production per output unit can still give producers a profit even when selling at a low price. So the competitiveness of sorghum depends upon increasing the yields and that is the orientation of our program. Among the best farmers in Niger we have consistently gotten over 2.3 tons. We need to extend this performance to Mali with the shorter cultivars. We need to increase the average farmers' yields in our program from 1.2 t/ha sorghum and 1.5 t/ha millet to 2.5 t/ha for sorghum and 2.0 t/ha for millet.

### **Supporting activities in which we need increased effort**

- 1) Our principal focus on markets outside of two survey articles has been on food processing. We need to connect better with the intensive poultry sector for our sorghum producing regions. Most important for this sector is getting substantially higher yields for sorghum. In Niger we have already gotten these higher yields and the farmers' groups have been selling to Harouna Labo, the largest egg producer in Niger with a good price premium.
- 2) We have not systematically analyzed how we should move to local seed production of high quality. This means increased uniformity with sufficient roguing. An understanding of the importance of isolation by farmers is also important.
- 3) The initial agronomy of new participants in the program has been poor. We have had to cajole and threaten to get farmers to improve their agronomy. A better initial orientation of new participants is needed to improve initial performance. We try to do this with the monitoring services we provide but more effort is necessary.
- 4) As we have farmers' groups reaching 150 ha and 150 members we need to conduct training courses in business and coop management and improve the transparency of the organization. This transparency is a critical point. These organizations need to win farmer confidence in order to be able to sell more of their grain in addition to the repayment of the input credits. They also need to be well managed to get bank loans. We need to find NGOs that can conduct the training and present it in modules in the local languages, first in Bambara for Mali.
- 5) Set up a better system to regularly incorporate new technologies. Presently, we have extended our local seed production activities to include some regional testing of new cultivars. We need to incorporate into our field operations evaluation of a series of

- technologies starting with different storage pest control techniques, secondly evaluating legume-cereal rotations with an emphasis on just fertilizing with P. The later is especially important as we move outside the cotton zone into the north of Mali.
- 6) Identify how to get involvement of local banks by developing the credibility and business management ability of the farmers' organizations. One goal is to get bank representatives involved early in the process of developing these farmer organizations, which already occurs in northern Nigeria. We should have a strategy for this from the initiation of the program with the first 50 ha.

**Production – Marketing Workshop**  
**“BUILDING A SUPPLY CHAIN FOR**  
**MILLET AND SORGHUM FOOD PROCESSING”**  
**August 12-14, 2008, Hotel Plaza, Bamako, Mali**

**Purpose of workshop**

August 12-14, 2008 a workshop for millet and sorghum food processors and farmers' associations and others working in this subject area in the West Africa Region was held in Bamako, Mali. This regional workshop had four objectives:

- 2) To indicate the importance of paying a price premium for clean grain and for the farmers to receive some of the benefits from the seasonal price increase. Clearly the processors need a supply of grain at harvest as well as throughout the year. Thus, grain sales need to be spaced throughout the year. If the processor wants to buy all the grain at harvest, then the farmers' associations should be paid a seasonal (as well as a quality) premium as if sales were spaced during the year.
- 2) To demonstrate the cleanliness of the grain threshed on the tarps, and if there are problems (as farmers' associations purchasing cheap tarps which develop holes when run over in the threshing process), to identify the problems and make modifications to the “bache” strategy;
- 3) To convince processors that there is potential to substitute sorghum for millet because we can increase sorghum yields much more than millet yields and because we are already doing well in linking millet processors with farmers' associations in Tingoni, Mali and Thiare, Senegal.
- 4) To build the contacts between the millet food processors and the INTSORMIL and IER food scientists. The Sahelian food processors often accuse us of doing too much for the farmers' associations and not enough for them. So we believe that these stronger relationships with food scientists will help consolidate the relationships between the farmers' associations and the Mali food processors.

# BUILDING A SUPPLY CHAIN FOR MILLET AND SORGHUM FOOD PROCESSING



HOTEL PLAZA  
BAMAKO, MALI  
AUGUST 12-14, 2008



## Objectives of the Workshop:

- Demonstrate the importance and viability of paying a premium for a clean, uniform grain supply;
- Insure the production of clean, uniform grain at the farm level;
- Facilitate the substitution of sorghum for millet and wheat;
- Build better ties between the food processors and the farmers' associations and between both and IER and INTSORMIL scientists.

## PROGRAM

### August 12 – Hotel Plaza

08:00 Registration

08:30 Welcome Address: Moderator – Botorou Ouendeba  
Bino Teme, DG of IER  
Mary Lou Carlson, Agricultural Programs, USAID- Mali  
E. A. Heinrichs, INTSORMIL

09:15 John Sanders: “Improving Cereal Grain Quality and Quantity and Paying for it.”

09:45 Discussion

10:00 COFFEE

10:30 Panel Discussion: Supplying Clean, Uniform Grain to Processors: What do We Need from Suppliers?

Mme. Deme Aissata Thiam, Danaya, Bamako  
Mme. Mariko Fadima, UCODAL, Bamako  
Mme. Deme Aissatou Diagne, Free Work Services, Senegal  
Pierre Ndiaye, Mamelles Jaboot, Senegal  
Mme. Cisse Fatchima, STA, Niger

12:15 – 13:30 LUNCH

13:30 Lloyd Rooney: “Experience with Sorghum Processed Food Products in Different Countries.”

14:00 Bruce Hamaker: “Substituting Sorghum for Wheat in Bread and Millet in Other Food Products.”

14:30 Discussion

15:15 COFFEE

15:45 Panel Discussion: Processors and Farmers' Associations: Needs and Costs  
Millet Food Processors from Mali, Niger and Senegal: Mmes: Deme Aissata Thiam (Danaya);  
Mariko Fadima (UCODAL); Cisse Fatchima (STA) and Pierre Ndiaye (Mamelles Jaboot).  
Representative from Tingoni Farmers' Association: B. Sandinan  
Representative from Thiare Farmers' Association: President GIE Thiare

17:15 End of Program

### **August 13 – Hotel Plaza**

08:30 Ababacar Ndoye, ITA, Senegal: "Experience of Thiare Farmers' Association in Selling to Millet Processors in Dakar and Policy Recommendations."

09:00 Pierre Ndiaye: "The Experience of Yaourt Jaboot in Obtaining Clean, Assured Supplies of Millet/Sorghum: Problems and Prospects."

09:30 Mamourou Diourte, IER, Mali: "2008 Program Activities in Mali."

10:00 COFFEE

10:30 Panel Discussion: Building Better Ties Between Farmers' Associations and Food Processors: Clean Grain, Prices and Contracts

Mamadou Diouf, formerly with ITA, Senegal

Marcel Galiba, SG 2000, Mali

Mme. Deme Aissata Thiam (Danaya)

12:15 LUNCH

13:15 Botorou Ouendeba: "Summing Up and Future Activities."

14:00 Visit to the firm of Mme. Deme Aissata Thiam (Danaya)

17:30 Return to the hotel

### **August 14 – Hotel Plaza**

08:00 Visit to the Tigoni Farmers' Association. Meet with the farmers, see storage facility, view millet in the field. Lunch in the field and return in the afternoon.

(Will travel by bus and then will have three vehicles on-site and rotate going out to see the millet fields.

While one group talks with farmers another group goes into the field and/or inspects the storage facilities.

This will be an excellent time to see millet and talk to farmers.)

## **Décrue Sorghum**

### **Drs. Vara Prasad and Scott Staggenborg**

The **décrue sorghum** activities are led by Vara Prasad and Scott Staggenborg, Kansas State University, Mamadou Diourte, Sorghum Program Leader, IER, Sotuba, Abdoul Wahab, IER, Traore, IER Sotuba and Samba Traore, Agronomist and Director of the Cinzana Research station of IER. Activities are conducted in collaboration with the sorghum program scientists from IER, Sotuba. The goal is to identify agronomic practices that lead to increased yields and increased quality of post water recession grown sorghum. Activities to be conducted by IER scientists will include cultivar collections and testing to identify most suitable cultivars for the region, testing of various cultural practices (cultivars, planting techniques, fertilizer regimes, pest management strategies including weeds, insects and plant diseases), and transfer of suitable technologies identified to farmers.

### **Global Objective**

To generate improved agronomic techniques along with appropriate décrue sorghum cultivars to sustain food production and foster economic improvement of northern Mali

### **Specific Objectives**

1. To determine farmers' perceptions and knowledge about current management practices and farmers' needs and preferences and at the same time to collect the sorghum cultivars grown in the area.
2. To conduct experiments on integrated soil, water, nutrient and décrue sorghum management strategies for improved productivity.
3. To diffuse the generated improved techniques.

### **Activities**

**October 2007 visit to Mali sites**

# K-State Agronomists Help West African Farmers Increase Sorghum and Pearl Millet Production

by Katie Starzec

Kansas State University Agriculture Experiment Station and Cooperative Extension Service, Manhattan, Kansas (kstarzec@ksu.edu)

Grain sorghum is an important crop not only to farmers in Kansas, but to farmers in many countries in Africa.

Some of the production challenges are the same, but many challenges are different or more severe in West African countries, said Vara Prasad, assistant professor of agronomy at K-State. West African farmers battle against drought, soil infertility and parasitic weeds.



**Vara Prasad Holding the Panicle of a High Yielding Sorghum Variety in Niger**

In October, Prasad and Scott Staggenborg, associate professor of agronomy, traveled to several countries in West Africa to kick off the beginning of a four-year program funded by the United States Agency for International Development and collaborating organizations in the U.S. and in host countries. The program is managed by the Sorghum, Millet and Other Grains CRSP (INTSORMIL) located at the University of Nebraska-Lincoln.

The Global INTSORMIL program involves 17 U.S. scientists at six universities (Kansas State University, Purdue, Texas A&M, West Texas A&M, Ohio State University and University of Nebraska-Lincoln), the USDA and 23 host country national research programs. The INTSORMIL mission is to use collaborative research to overcome constraints to sorghum, millet and other grains (fonio, tef and finger millet) production and utilization for the mutual benefit of agriculture in the U.S. and developing countries in West, East and Southern Africa and Central America.



**INTSORMIL Regional Project Sites in Africa**

The purpose of INTSORMIL is to find ways to improve production practices in those countries. West African farmers face serious problems of a localized and volatile market, the agronomists said.



**Harvested Sorghum Heads in Bundles**



**Stack of Pearl Millet Heads**

"We traveled to Mali, Niger, Ghana, and Burkina Faso. Everything in those countries is done by hand; sowing, weeding, fertilizing and harvesting," said Prasad. He and Staggenborg, who is a cropping systems specialist with K-State Research and Extension, will work to increase the water-use efficiency of the farmers' cropping practices to better cope with drought conditions.



**Scott Staggenborg and Collaborators Jesse Naab (Ghana) and Hamidou Traore (Burkina Faso) in Burkina Faso**

The K State scientists observed great diversity in the cultivars of sorghum grown in West Africa.



**Sorghum Heads Showing Diversity in Head Form and Color**

Prasad and Staggenborg observed the "zai" systems that many farmers there use to conserve water. "They dig numerous shallow holes in the ground, wait for rain, then plant one seed in each water-filled hole," said Prasad.

A new "half-moon system" is being used on an experimental basis in some fields. "In this system, a series of crescent-shaped mini-terraces is constructed on a sloped field to create a series of small catch-basins to collect water as it flows down the field. The seeds are planted in these half-moon shaped basins with rock walls to conserve water. A form of

terracing to complement this half-moon system is also being researched, and we are trying to extend both of these technologies to a number of villages," said Prasad.



**Sorghum in Niger Growing in Half-Moon Shaped Basins with Rock Walls to Conserve Water**

"Fertilizer is not as readily available in Africa as it is in the United States, mostly for financial reasons", added Staggenborg.

"To make the infertile soil more suitable for crops, farmers can purchase smaller, more affordable bags of fertilizer to divvy up among the plants. Farmers usually have only one or two acres," the agronomist said.

"Those who own goats and cattle have the option of mixing the fertilizer with organic manure so they can apply more over a larger area. There is also potential for composting", said Prasad, though it is not yet being practiced.

Leaving crop residues on the fields would help put nutrients back into the soil, but residues are often used for other purposes, he said.

"People use the sorghum and millet grain for their own consumption, but the residues are gathered or sold for livestock fodder. Because of its financial value, it is difficult for farmers to leave the residues on their fields. Also, any abandoned residues might be stolen."



**Sorghum Field in Niger**

Another problem they are working on is striga, a parasitic weed that saps the crops' resources during stress conditions. "Potential solutions for this are crop rotations and herbicide-treated seeds, which are being developed at K-State", Prasad said.



**Striga in Niger**

"The West African market for grains is extremely sensitive. In the U.S., demand may shift from one crop to another as prices go up and down, but in Africa, a price increase directly affects a large area because of their lack of efficient transportation", Staggenborg said.

Prasad and Staggenborg visited universities in several countries, and will work with the faculty to help improve their curriculum and to get information on sorghum and pearl millet production technologies to more farmers. "West African farmers are eager to learn; getting the knowledge to them will be the key", the scientists said.



**January 2008 visit to Mali sites**

*A visit was made to the décrue area associated with Lake Faguibine near Goundam, Mali in late January of 2008 by Scott Staggenborg. During this visit, several objectives were accomplished.*

- *We met with local administrators of the Lake Faguibine revitalization program in Goundam.*
- *We met with farmers from two villages surrounding the lakes Bintagoungou and Mgoudou to gather their input on how to improve décrue sorghum production in the region. Based on these conversations, we developed three research objectives for the first year. These objectives are:*
  1. *Characterize the soils in the lakes region where décrue sorghum is grown. The purpose for this objective is to determine the native fertility levels to confirm the local perception that no fertilizer is needed because the lake deposits nutrients during the flooding stage.*
  2. *Evaluate sorghum varieties in the region. We acquired seed from local sorghum varieties while visiting the village and have planted them along with IER improved varieties based on input from the sorghum breeder at IER.*
  3. *Evaluate management practices to reduce insect and disease pressure. Since the décrue sorghum is planted into relatively wet soils, it is feared that seedling diseases may be a problem, so treatments that include combinations of seed fungicide treatments and microdose (starter fertilizer) are being tested to determine if these easily adoptable technologies can improve sorghum yields in the décrue systems.*

*After traveling to the region and observing the lakes region, it was determined that working around Lake Faguibine was the most effective use of resources during the discovery stages of this project. The other lakes in the region do not have as many hectares of décrue potential. Some lakes do not have any potential sorghum hectarage because of the unsuitable elevation and layout. Also, the travel requirements for the scientists to conduct this research are quite daunting. It requires approximately one and a half days to reach Goundam via ground travel and then most of the villages require approximately one hour of travel through the lake region. This travel is difficult as it must occur on seasonal/semi-permanent roads. I still believe that knowledge that is transferable and will have an impact can be attained in the first year. But I want to explain that there are obstacles to attaining some of the original scope proposed (such as conducting research at every lake in the region and also working extensively in the Gao area). If the scope of this project is to be expanded as originally proposed, then it is likely that additional human resources will need to be added to the project.*

### **Varietal trials**

33 cultivars in 4 replications, one farmer's field considered to be the replication. We have 2 farmers at Bintagoundoun and 2 farmers at Takabangoun.

### **Breeding plots**

These cultivars were planted from March, 29th to April, 1<sup>st</sup> 2008. Twenty varieties from the IER sorghum breeding program and thirteen from the farmers were planted at Bintagoungoun (2 sites) and Toukabangou (2 sites).

**Results:** The experiment is doing well at Bintagoungou (2reps) only. We do not expect to get results from the second location due to the farmer's behavior.

### **Agronomy trials**

#### **Experiment 1: Compare improved technologies to farmer's cultural practices.**

**Location:** Bintagoungou. Randomized complete block design was used with five replications.

**Treatments:**

PD1: Plant population based upon farmer's cultural practices (row spacing of 1m x 1 m).

PD2: PD1 + the use of Furadan for soil treatment and Apron Starr for seed treatment.

PD3: Plant population based upon row spacing used by research scientist (0.8 m x 0.60 m) + the use of Furadan for soil treatment and Apron Starr for seed treatment.

PD4: PD3 + 20 g of Diammonium phosphate per hill

PD5 PD3 + 40 g of Diammonium phosphate per hill

**Preliminary results****Table 1: Actual and expected number of hills in this experiment at Bintagougou, 2008-09.**

<b>TREATMENTS</b>	<b>Actual Number of hills (1)</b>	<b>Expected number of hills (2)</b>	<b>% of germination (1) / (2) *100</b>	<b>Germinated hills per ha (GHPH)</b>	<b>GHPH %PC1</b>
PD1: Farmer's practice (1 m x 1 m)	27	30	91	9444	100
PD2: (0.80 m x 0.60 m) 3 plants per hill	43	60	71	14792	157
PD3: PD2 + Apron+ Furadan	46	60	77	15972	169
PD4: PD3+ 2 coffee spoons of DAP	20	60	34	7083	75
PD5: PD3 + 4 coffee spoons of DAP	12	60	20	4236	45
Mean	30	54	59	10306	

The germination observed on the basis of the ratio of actual to expected number of hills, was good in farmer's practice (91% ), fairly good in recommended practices with apron and Furadan application (77 %), and bad with recommended practice with fertilizer application ( 20 %). In terms of spatial occupation by the crops, expressed by the actual number of hills per ha, three distinctive classes of treatments are shown: a) Recommended research practice with no fertilizer application (15972 hills per ha on average); b) Recommended research practice with fertilizer application: (7083 hills per ha on average); c) the farmer's practice (with 9444 hills per ha) lying between the two classes (Table 1).

**Conclusion: Preliminary results indicate the benefit of protecting the soil and the seeds at planting.**

Soil was sampled at 0-20 cm and 20-40 cm layers on the basis of one sample per replication. These samples are waiting to be analyzed. Soil granulometry, organic matter, pH, total and available P, Sum of exchangeable cations (Na, Ca, K and Mg) will be determined.

**Experiment 2. Effect of thinning, soil and seed treatment on plant population and yield**

**Treatments:** (Trials were planted from April 1-3, 2008)

T1= No treatment, 1mX1m spacing, no tillering

T2= Apron star treated, 1mX1m spacing, 1 plants/hill after germination

T3=Apron star and Furadan treated, 1mX1m spacing, 2 plants/hill 15 days after planting

T4= Apron star and Furadan treated , 1mX1m spacing, 3 plants/hill 15 days after planting

**Locations:** The trial was conducted at Bintagoungou and Toukabangou) with a split-block design.

Factor A: Cultural practices as column factor

PD1: Planted seeds on 1 m x 1m and thinning on 1 plant basis.

PD2: Planted seeds on 1 m x 1m and thinning on 2 plants basis

PD3: Planted seeds on 1 m x 1m and thinning on 3 plants basis

PD4: Farmer's practice (planted seeds on 1m x 1m)

Factor B: Soil and seed treatments as row factor:

No treated (check)

F: Soil treated with Furadan (F)

A: Seeds treated with Apron Stars;

A+F: Combination of soil treatment with F and seed treatment with

## Preliminary results

### 1. Effect of planting density

The germination observed by the ratio of actual to expected number of hills, was about 58 % on average (Table 2). It was not affected by planting density, which was expected, because of the same planting geometry (1m x 1m) observed on PD1, PD2, PD3 and PD4. The low % of germination observed in a number of hills may be due to moisture variability. Plant population related to farmers' practice, and its effect on sorghum grain yield will be recorded, based on the number of plants observed per hill (3 scenarios in this study) by researchers.

### 2. Effect of soil protection with Furadan and seed protection with Apron Star

Treating seeds with Apron Star and soil with Furadan affected plant population per ha (Table 2) and their effect on grain yield will be recorded at harvest.

**Table 2: Actual and expected number of hills in this experiment at Bintagoungou, 2008-09.**

Thinning treatments	Actual Number of hills (1)	Planned number of hills (2)	% of germination (1) / (2) *100	Germinated hills per ha (GHPH)	GHPH %PC1
COLUMNS (Thinning)					
PD1: (1m x 1m) 1 plant per hill	15	25	61	6354	100
PD2: (1m x 1m) 2 plants per hill	15	25	59	6188	97
PD3: (1m x 1m) 3 plants per hill	14	25	55	5688	90
PD4:No thinning	14	25	56	5813	91
<b>Mean</b>	<b>14</b>	<b>25</b>	<b>58</b>	<b>6010</b>	
ROWS (Soil and seed treatments)					
Not trated	14	25	57	5938	100
Apron star (A)	15	25	59	6125	103
Furadan (F)	15	25	59	6146	104
A+F	14	25	56	5833	98

<b>Mean</b>	<b>14</b>	<b>25</b>	<b>58</b>	<b>6010</b>	
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NB:

1. PD4 corresponds to the farmer's practice in planting density treatments; it differs from PD1, PD2, and PD3 by the number of plants per hill after thinning.
2. Soil moisture was not measured due to the lack of equipment
3. Grain, stem and biomass yield will be recorded at harvest.
4. Number of tillers was not measured after thinning (20 days after emergence).

#### **Conclusion:**

Data were not collected from the varietal trials. From the two agronomic trials, **preliminary results indicated the importance of treated seeds and the soil at planting**. The up coming data will be more consolidated to draw precise conclusions.

## **Processing Technology Dr. Bruce Hamaker**

### ***Processing Technology and Training Dr. Bruce Hamaker***

*The overall goal of the cereal **processing technology and training** component of the project is to establish a successful model of entrepreneurial sorghum/millet processing to competitive marketed food products. Year 1 activities focus on organization of the project, strengthening the IER Food Technology unit, and identifying processors to work with, preferably in the Mopti area. A consultant, Mr. Mamadou Diouf, with extensive expertise and experience in sorghum/millet processing and working with entrepreneurs (a former leader of the FAO initiative PROCELOS working with food processor groups, and was a food technologist with the Institut de Technologie Alimentaire, ITA, Dakar) was selected to assist with this activity.*

### **February 28 visit to Mali**

*The project was initiated with a planning and partner identification trip to Mali in February 14-22. The group consisted of Bruce Hamaker (INTSORMIL, PI), Mamadou Diouf (consultant, Institut de Technologies Alimentaire, ITA, Dakar, former head of PROCELOS) and Ms. Yara Kouressi (IER/Sotuba, Mali project PI). Meetings were had with the USAID mission personnel, Bamako area processors and national processor's association (FENATRA), and processor groups in Mopti and Gao areas. The project will partner with six (6) processors and their associations in the Mopti and Gao locations, and will proceed with primary cereal processing equipment purchases and training later this year. B. Hamaker and M. Diouf additionally met in Senegal at the Institut de Technologie Alimentaire (ITA) with the interim Director General, Dr. Ababacar N'Doye prior to the Mali trip to discuss strategies and plans.*

*The following were achieved in this first mission of the processing project:*

- *There was a meeting with the Accelerated Economic Growth team of Mali USAID Office and the team's strategy and initial plan was received and commented on.*
- *In the two regions, Mopti and Gao, covered by the project, stakeholders were convened and were sufficiently representative. They approved of the goals and approach of the project, and selected beneficiaries or partners who will be part of the project. They all seemed to meet the criteria we had set for partners.*

*Other comments:*

- *Conditions for implementing the project appear to be quite favorable for achieving the objectives in a timely manner.*
- *The situation perhaps is even more favorable for local processors considering the rise in cereal prices at the international level. Sub-regionally, there has been a resurgence of interest in alternative foods to counter expensive imported cereals and products, including rice and those that are wheat-based.*
- *The stakeholders spoke of constraints faced by them. Their principal concern is supply of quality grain, and packaging and marketing of finished products, as well as the lack of proper processing equipment.*
- *The team recommends that the project also include a survey to identify products derived from millet and sorghum commonly used in the project area, as well as those for which a market bearer exists in other parts of Mali, and for export. Partnerships could as well be established with organizations with projects working in the same or peripheral areas as this project, such as PCDA, IMS and FENETRA*

## **August 2008 visit to Mali**

The INTSORMIL PI for the Processing Technology component, Dr. Bruce Hamaker, Purdue University attended the Production – Marketing Workshop August 12-14, 2008, Hotel Plaza, Bamako, Mali and presented a talk on “Substituting Sorghum for Wheat in Bread and Millet in Other Food Products.” After the Workshop he traveled to the Sotuba, Gao and Mopti areas with his NARS colleagues, consultant Mr. Mamadou Diouf (formerly of ITA/Senegal) and Ms. Yara Kouressi of IER/Sotuba. Based on their discussions several activities were developed. In Mopti, on August 15, 2008 the team formally launched the processing project in the region. Six entrepreneurs and their associates were chosen during a February 2008 trip to the region, and participated (see photo) with local administrators, IER representatives, and NGO personnel in the launch and meeting covering project goals and objectives as described below. Basic processing equipment items are being procured for a training workshop planned for February 2009.



**Launching of the Processing Technology component in Mopti, August 2008. Six entrepreneurs and their associates, local administrators, IER representatives, and NGO personnel participated**

Overall activities of the processing technology component include (1) A small-scale market economic assessment of current status and opportunities for sorghum and millet processed foods in the Mopti/Gao region; (2) In the Mopti/Gao region, continuation and expansion of activities with six current processor groups, including increasing mechanization and market opportunities; (3) Conduct training sessions on small mechanized processes for high quality commercialized sorghum and millet products; and (4) Contractualization linkages with the production-marketing project to provide high quality grains to processors and markets to producers. Specific equipment purchases will be made, but only to complete cereal processes that are deemed to have market potential. The project will organize training for capacity building of entrepreneurs and their employees and for scientists to share experiences from advanced NARS institutions and successful entrepreneurs.

## **Modification of Cooperative Agreement**

**#:688-A-00-07-00043-00**

A proposal was submitted September 23, 2008 in response to an RFA dated August 26, 2008 from the USAID Acquisition and Assistance Office, Bamako, Mali for a modification of Cooperative Agreement #: 688-A-00-07-00043-00, to expand the program activities of the Leader with Associates Award: EPP-A-00-06-00016-00, "Transfer of Sorghum and Millet Production, Processing and Marketing Technologies in Mali." The proposal will extend, if approved, the current contract period, September 29, 2007 to September 30, 2010 to September 29, 2013. This proposal contains a Technical Application and Financial Plan for the proposed modification.

This revised project includes the (1) **Production-Marketing**, (2) **Food Processing** and (3) **Décrue Sorghum** components and is designed to accelerate the movement of sorghum and millet production technologies onto farmers' fields, link farmers' organizations to food and feed processors and to commercialize processing technologies so as to enhance markets by expanding the technical knowledge basis and developing technology development and transfer capacity within IER. To achieve this we propose to (1) expand to new sites with more concentration in Northern Mali, (2) upscale the research, (3) upscale the technology transfer component and (4) upscale the training component (academic and short term) of the current Cooperative Agreement # 688-A-00-007-00043-00.

## Objectives

1. Develop stronger farmers' groups and enhance farmers' groups marketing power
2. Facilitate adoption of production and marketing technologies to improve the productivity of sorghum and millet and increase farmer incomes
3. Develop alternative markets (food, beverages and feed) for sorghum and millet
4. Develop sorghum production technology for the décrue farming systems in the northern regions
5. Upscale the sorghum and millet seed production industry in collaboration with other agencies
6. Disseminate technology via media (communications/publications/website)
7. Build institutional (IER) technology development and transfer capacity through long term (academic) and short term training

## Project Components

*Production – Marketing Activities 2009-2013*

**Karfara:** Karfara has long been the preferred site for field testing the new sorghum cultivars of IER. On farms on which the agronomy was done well with the weeding and tied ridges, the yields of the new caudatum cultivar, Niathichiama, with inorganic fertilizer were good. With the achievement of good agronomic results the focus now needs to be on strengthening the farmers' organization and the marketing components. There are no extension representatives or NGOs here but IER technicians have worked here for a long time doing demonstration trials.

**Dioila:** This is a cotton zone. Farmers are very discouraged by the price-cost squeeze in cotton production so it is an opportune time to be introducing an alternative crop. Moreover, farmers have already been borrowing from CMDT and micro credit sources to finance the inorganic fertilization of sorghum.

**Tingoni:** Continue and expand the number of farmers. Yields here are good when using (1) the improved millet cultivars developed by Niangado of Toronou, (2) three sacks of inorganic fertilizer, and (3) water harvesting. The Tingoni region is known for its clean millet.

**Koutiala:** Provide farmers seed of a regionally tested caudatum, Grinka. As cotton continues to be a problem in Koutiala with the price-cost squeeze the area can continue to be increased. Sorghum substitutes for millet in food consumption during bad rainfall years so the price goes up along with millet. In these years we also need to be selling sorghum as an intensive poultry feed. We work with a very effective NGO, AMEDD, in the region.

**Kolokani and Mopti: New production regions in 2008:** Organize with farmers' associations the introduction of new technologies and marketing strategies.

**Training in seed production and marketing concepts for the Tingoni farmers' association:** It is important for the officials and the farmer members to better understand the marketing concepts and the economic functioning of a coop, specifically on how to perform services for farmers and to get better member participation by splitting the profits from economic activities and thereby creating more member incentives to participate. Continue and expand farmers' meetings and have discussions about the production of high quality seed, marketing concepts and the things the producers association must do to build confidence in the membership and thereby increase its role in the marketing.

**Study on intensive poultry production in Mali:** Undertake the survey of intensive poultry producers. The market for feed grain for sorghum in intensive poultry production is a method of creating a floor price for sorghum in normal and good rainfall years. Feed for intensive poultry production is the main expansion field for sorghum in the future in West Africa. With rising incomes the consumption of chicken increases rapidly and chicken becomes the principal food for middle and then even low income consumers. So it is important to increase local production of cereals so the changing consumption patterns have the maximum effects on the local economy and Mali does not have to import feed grains once this change in consumption patterns and the poultry expansion begin. Important data to be collected are a) the number of intensive producers of chicken, b) where they get their rations, c) components of the ration and d) how poultry producers make sure that they are nutritionally adequate, e) their use of maize and/or sorghum in the ration, and e) whether they have a mixer (broyeur-melangeur), so they can mix their own rations.

The activities will focus on strengthening the IER Food Technology unit, and identifying processors to work with, in the Mopti area as well as other identified areas decided upon by IER and INTSORMIL scientists, and with USAID/Mali office input. This model should be attractive to adoption by a significant number of entrepreneurs, particularly women in Mopti, Bandiagara, the Gao region, but also in other zones to both provide a market outlet for farmer's grain and as an income generation activity. It will additionally include incubation centers established at IER Sotuba and Mopti Research Centers where equipment will be demonstrated and entrepreneurs will be trained, and some refinement of processing technologies and testing of markets can be made

The project's incubator initiative is designed to provide start-up entrepreneurs with a supportive environment of equipment, services and resources. This activity will build on the central cereal processing facility at IER Sotuba to make this the principal incubator, thus able to provide training for entrepreneurs from rural areas of Mali (particularly in this case in the Mopti/Gao region, but also in other regions) as well as in the Bamako area. Specific equipment purchases will be made, but only to complete cereal processes that are deemed to have market potential. A smaller and more focused incubation center will also be considered for the IER Mopti Research Center that can provide a focal point in the northern region for training on decortication, milling, and agglomeration technologies and business skills. These activities will depend on facilities for product optimization, training, actual processing and market testing, and backstopping new and existing enterprises. The project will organize training for capacity building of entrepreneurs and their employees and for scientists to share experiences from advanced NARS institutions and successful entrepreneurs. Training will focus mainly on:

- Raw material management (producing quality grain supply, storage, cleaning)
- Quality management and sanitation (HACCP)
- All processing aspects
- Packaging/labeling
- Management skills and loan acquisition

Training programs will be designed to improve business profitability, and product quality and marketability. The number of beneficiary entrepreneurs is estimated, over the 5 year period, at 100, of which approximately 20 entrepreneurs will develop functioning or improved enterprises supported through the food technology units in the 5 year period. This will provide the model for other entrepreneurs to follow.

**Activities will include:**

- A small-scale market economic assessment of current status and opportunities for sorghum and millet processed foods in the Mopti/Gao, Bamako, and broader regions.
- At IER Sotuba, procurement of specific equipment pieces to complete cereal processing units for production of high quality sorghum/millet flours and grits, agglomerated products (couscous, degué, etc.), and pregelatinized 'instant' flours for thin and thick porridges. At IER Mopti, consideration of procurement of a grain cleaner, decorticator, and mill for training and demonstration purposes to entrepreneurs of the northern region.
- In the Mopti/Gao region, continuation and expansion of activities with six current processor groups. Linkages with Bamako and other regional markets will be explored through studies set up with an IER market economist. Increase number of entrepreneur partners in the project.
- Conduct training sessions on small mechanized processes for high quality commercialized sorghum and millet products. Will include hands-on training on equipment, grain quality issues, packaging, marketing, and business operations.
- Contractualization linkages with the production-marketing project to provide high quality grains to processors and markets to producers. A joint workshop will be proposed with

the production-marketing group in the Mopti/Gao region to bring the actors together and show advantages to contractualization and improved returns to producers.

### ***Décrue Sorghum Activities 2009-2013***

The **décrue sorghum** activities will be conducted in collaboration with the sorghum program scientists from IER, Sotuba and will initially be conducted in the Mopti and Tombouctou area. With success in those two regions the activities can later be expanded to the Gao area. The goal is to identify agronomic practices that lead to increased yields and increased quality of post water recession grown sorghum. Activities to be conducted by IER scientists will include cultivar collections and testing to identify most suitable cultivars for the region, testing of various cultural practices (cultivars, planting techniques, fertilizer regimes, pest management strategies including weeds, insects and plant diseases), and transfer of suitable technologies identified to farmers.

#### ***Activity 1: Identification in the 'décrue system' through participative research, of constraints to sorghum production, and related farmers' strategies.***

Constraints and strategies related to cropping sorghum in the décrue system will be identified through the use of MARP (an NGO) in Tombouctou around four lakes (Fati, Faguibine, Takadji, Horo). One village per lake will be selected to complete database (cultivars and strategies employed for water, nutrient and pest management) on the décrue sorghum. ONG and public extension services, will be involved for the use of any existing information on constraints related to sorghum production, as well as strategies to tackle them.

#### ***Activity 2: Assessing sorghum cultivars in the décrue system through participative research.***

On the basis of the outputs above, (list of available technologies related to sorghum in the décrue systems and of farmers appreciation based on their own criteria), available cultivars will be planted on farms in Tombouctou, Mopti and Gao. The seeds will be collected and stored for future assessment of their genetic traits. Results from the on-going trials in Tombouctou in 2008-2009 will be used to focus research projects in the Mopti and Gao areas in later phases of the project.

#### ***Activity 3: Assessing local cultural practices through participative research.***

Available cultural practices selected will be suggested for a comparative study, based on scientific knowledge accumulated from rainfed sorghum. Observation plots (four) will be conducted on farms, composed of a:

- a) crop management technology
- b) nutrient and water management technology
- c) pest management technology
- d) farmer's technology

The study will be conducted on farms (6 farmers per location on the basis of 3 reps per farmer) in three locations (to be identified around IER stations or substations in the décrue zones).

Data will be recorded on: 1) plant parameters (sorghum grain, stems and biomass yield); 2) soil parameters (clay, sand and lime content) and 3) water parameters (soil moisture during the reproductive phase)

***Activity 4: Selecting Sorghum cultivars in the 'décrue system' for nutrient and water use efficiency through participative research.***

Available cultivars in the 'décrue system' previously selected by farmers, based on their own criteria, will be assessed for nutrient and water use efficiency in a controlled environment and field conditions at on-station (under rainfed and irrigated conditions). Cultivars will be grown under low and high levels of nutrients (N or/and P in pots) and water (rainfed and irrigated in a field study) as well as their interactions.

Data will be recorded on: a) plant parameters (sorghum grain, stems and biomass yield, root length and weight); and b): water parameters (total amount of used water at different stages of plant development).

***Activity 5. Soil nutrient deficiencies studies in the décrue system.***

Nutrient availability in soils of the décrue system will be assessed using sorghum response to the following fertilizer treatments:

1. NPK
2. NPKS
3. NPK (-P)
4. NPK (-N)
5. NPK (-K)
6. No fertilizer

This activity will be conducted on farms (2 farmers per location with the basis of 3 reps per farmer) at three locations (to be identified around IER stations or sub-stations in the décrue zones). Data will be recorded on a) plant parameters (sorghum grain, stems and biomass yield) and b) soil parameters (texture, pH, and organic matter, P available, Ca, Mg and Na).

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