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Transfer of Sorghum, Millet Production, Processing and Marketing Technologies in Mali Final Report September 21, 2007 – September 30, 2012

INTSORMIL

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Final Report

September 21, 2007 – September 30, 2012

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)

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Production-Marketing

Décrue sorghum

Food processing

Training

1. Acronyms and Abbreviations

ACRONYM	DESCRIPTION
AMTCL	**Association Malienne des Transformateurs des Céréales Locales**
AMEDD	**Association Malienne d'Eveil au Developpement**
BNDA	**Banque Nationale de développement Agricole Mali**
CONFIGES	**NGO/ Gao**
CRRA	**Centre regional de Recherche Agronomique**
DRA	**Division de la Recherche Agronomique**
FCFA	**Franc CFA**
Ha	**Hectare**
IER	**Institut d'Economie Rurale**
ITA	**Institut d'Technologie Alimentaire**
IICEM	**Integrated Initiatives for Economic Growth In Mali**
KSU	**Kansas State University**
LTA	**Laboratoire d'Tecnologie Alimentaire (IER)**
MOU	**Memorandum of Understanding**
MT	**Metric tonne**
NGO	**Non Governmental Organization**
RCGOP	**NGO/ Tomboctou**
SAA	**Sasakawa Foundation**
SOADEF	**SOciété Amara Doucouré Et Fils**
WFP	**World Food Program**
WTAMU	**West Texas A&M University**

2. Introduction

This report covers the period September 21, 2007 – September 30, 2012. As per the request of the Mali/USAID Mission this project was designed to promote food security and reduce poverty of vulnerable households by increasing yields and incomes of Malian sorghum and pearl millet producers in a sustainable way. This report details the major results obtained under the Cooperative Agreement # 688-A-00-007-00043-00 with its four components: (1) Production-Marketing; (2) Décrue Sorghum; (3) Food Processing and (4) Training. The project was designed to move sorghum and millet production technologies from the experiment station onto farmers' fields, link farmers' organizations to food and feed processors and to commercialize processing technologies so as to enhance markets. The program emphasis in the north was on the development and transfer of décrue sorghum technology, while in the south the transfer of rain fed sorghum and millet technology was accelerated. A training component was designed to strengthen IER technology development and transfer capacities so as to expand and continue the activities initiated by this project.

Objectives:

- **Facilitate adoption of production and marketing technologies to improve the incomes of sorghum and millet producers**
- **Facilitate the development of markets for the use of millet and sorghum as a food for humans and as a feed for poultry**
- **Develop stronger farmers' groups and enhance their marketing power**
- **Extend mechanized food processing technologies to entrepreneurs and processor groups**
- **Introduce improved agronomic practices into décrue farming systems in northern Mali**
- **Develop and strengthen effective partnerships with all stakeholders**
- **Strengthen human and institutional capacity to sustainably increase the production of sorghum and pearl millet**

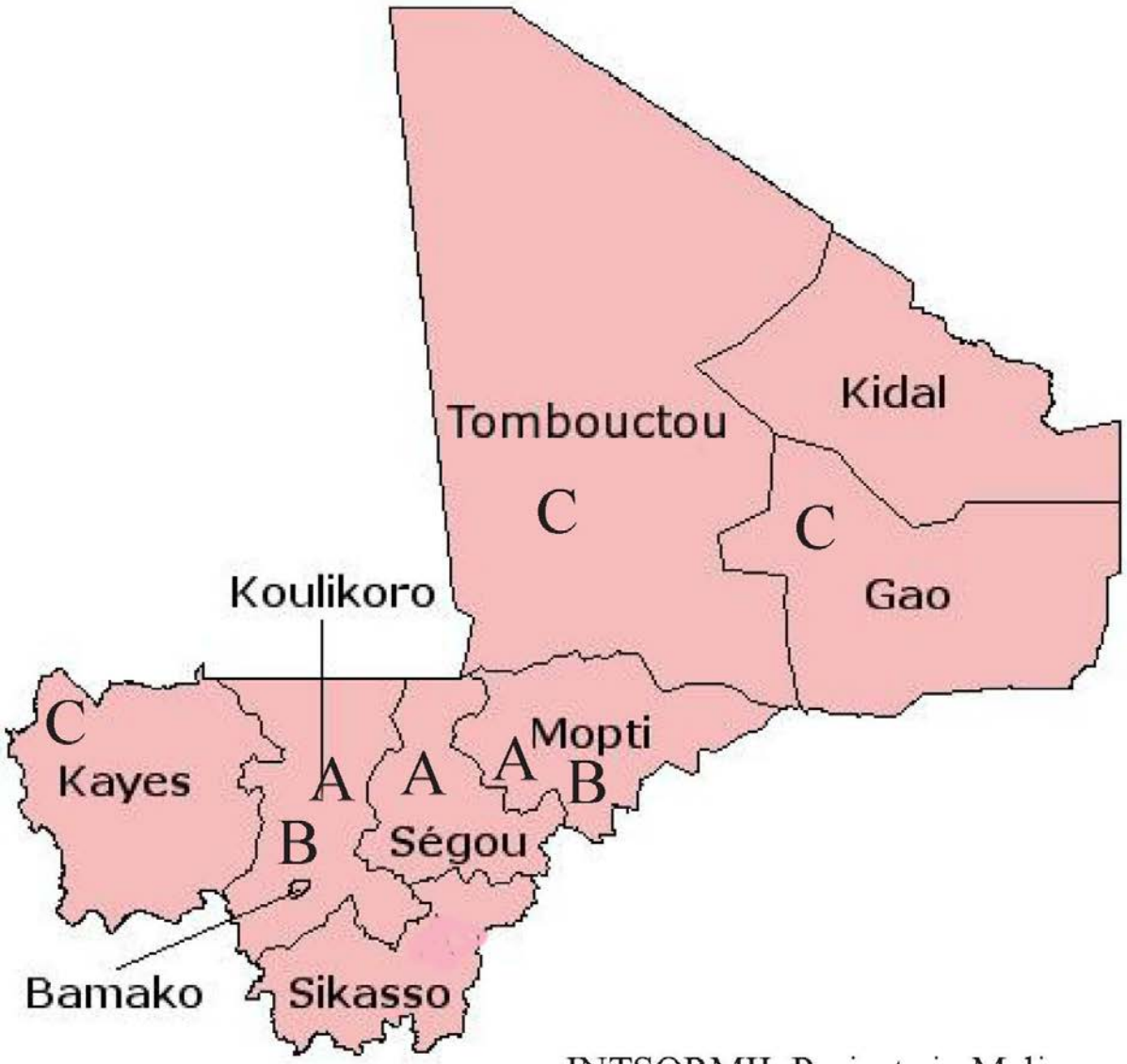
Implementing Partners:

Africare**	**NGO**

AMEDD**	**Association Malienne d'Eveil au Developpement**
BNDA**	**Banque Nationale de développement Agricole Mali**
CONFIGES**	**NGO/ Gao**
CRRA**	**Centre regional de Recherche Agronomique**
DRA**	**Division de la Recherche Agronomique**
IER*	**Institut d'Economie Rurale**
KSU*	**Kansas State University**
IICEM**	**Integrated Initiatives for Economic Growth In Mali**
Purdue*	**Purdue University**
RCGOP**	**NGO/ Tomboctou**
SAA**	**Sasakawa Foundation**
WTAMU**	**West Texas A&M University**

*Prime partner
**Sub-prime partner

Geographic areas of coverage:



INTSORMIL Projects in Mali

A = Production and Marketing

B = Food Processing

C = Décrue Sorghum

3. Executive Summary

This report covering the period September 21, 2007 to September 30, 2012 details the major results obtained under the Cooperative Agreement # 688-A-00-007-00043-00 with its four components: (1) Production-Marketing; (2) Décrue Sorghum; (3) Food Processing; and (4) Training. This project was designed to move sorghum and millet production technologies from the experiment station 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 followed a value chain approach to improve the supply chain from the farm level to the consumer. The program emphasis in the north was on the development and transfer of décrue sorghum technology, while in the south the transfer of rain fed sorghum and millet technology was accelerated. A training component was designed to strengthen IER technology development and transfer capacities so as to expand and continue the activities initiated by this project. Major Project achievements are summarized below.

Mali Feed the Future Strategy- Based on the success of this project the new USAID-Mali Feed the Future initiative now includes millet and sorghum as priority crops. Since grains of these crops are the main ones consumed by humans in Mali, demonstrating the potential of these crops for higher yields, incomes, and market expansion may be our most important contribution.

Perception change- Our results changed the popular perception that 1) sorghum and pearl millet are subsistence crops, 2) sorghum and pearl millet do not respond to fertilizer, 3) farmers cannot increase income by fertilizing their crop and thus will not apply fertilizer and 5) banks will not provide credit to apply fertilizer to sorghum or millet.

Demonstration of a successful production and marketing model- We demonstrated that our model of sorghum and millet production and marketing could substantially increase yields, prices and incomes. Annual reports of these parameters were published in bulletin format.

Demonstration of a successful extension model- We successfully demonstrated a new extension model of village level activity as previous demonstration trials with cereals in the Sahelian countries have generally been unsuccessful.

Value chain approach- We followed a value chain approach in our technology development and transfer activities. Our intervention points along the chain were at the following levels: Inputs→ Producer→ Grain storage→ Processor/market/poultry farmer→ Market expansion→ Retail distributor→ Consumer. A value chain is the recognition that the value of the product is created by the producer (farmer) plus a number of activities along the chain to the consumer. A value chain approach is especially important in reducing poverty and increasing food security of vulnerable groups such as smallholder farmers and female headed households because these groups have the fewest commercial relationships and reap the fewest benefits from these economic activities.

Technology development and transfer activities- 1) Five Improved sorghum varieties (Grinkan, Niatichama, Seguifa, Tiandougou and Tiandougou coura) and one improved millet variety (Toroniou) have been successfully disseminated in five regions in Mali from 2008 to 2012, 2) Promotion of proper grain storage through the construction of storage structures by collaborating NGOs, providing advice on the management of storage pests and by introducing triple layered hermetically sealed bags to control grain storage insects, 3) Transfer of sorghum production technology to farmers via on farm demonstrations and the formation of farmers' associations and linking the farmers to the value chain in 19 villages from 2008-2012 covering 2,852 ha, 4) Transfer of millet production technology to farmers via on farm demonstrations and the formation of farmers' associations and linking the farmers to the value chain in 8 communes and 10 villages from 2008-2012 covering 3,544 ha, 5) 1,860 hectares were placed under improved technologies or management practices in 2012, 6) 1,690 vulnerable households are benefitting from improved technologies or management practices in 2012 and 7) This is the first comprehensive research conducted in the décrue systems in the northern region of Mali.

Success of sorghum cultivar Grinkan- A high yielding IER bred cultivar Grinkan was planted on about 3,000 ha in Mali in 2012 through INTSORMIL and IICEM collaboration. We also introduced Grinkan into Burkina Faso and Niger with excellent results. The project was instrumental in moving Grinkan technology out of the research station and onto farmers' fields.

Rural income- Where improved millet/sorghum varieties + management practices have been adopted in Mali, the farmers have become rich through the sale of the clean grains to traders. As one of many examples, farmers at Garasso annually sell 25,000,000 FCFA of Grinkan. With 1,860 ha under improved technologies and a one ton/ha increase through the use of the Grinkan sorghum variety + the improved package of practices we estimate a 1,860,000 kg increase in sorghum grain in Mali in 2012.

Extension and marketing strategy developed-The integration of the technical extension and marketing aspects of the project are critical to be able to finance the additional inputs needed to overcome the soil fertility constraints. Income gains were achieved by 1) producing clean (sand, dirt and stone free) millet, 2) selling later in the year when prices rebound, 3) finding new markets, especially millet food processors, and later in the marketing chain, village or local town merchants and by 4) increasing the bargaining power of farmers through group sales and input purchases via the farmers' associations.

Scaling up- There was a substantial scaling up our technology-marketing-institution model in 2010-2012 by IICEM and Global 2000. With a 5,000 ha goal of IICEM in 2012 and an expected increase of 1 ton/ha this has the potential of increasing production by 5,000,000 kg of grain in the battle against hunger.

Model villages- Development of model agricultural villages in the different regions, which are now very well known for their sorghum and millet production: Garasso in Koutiala, Tingoni in Segou, and Kountogoro in Mopti.

Package of recommended practices from sowing to marketing developed- 1**)** Sorghum (in French), 2) Sorghum (in Bambara), 3) Millet (in French) and 4) Millet (in Dogon), 5) Décrue sorghum for North Mali (Mopti/Tombouctou) and 6) Décrue sorghum for South Mali (Kayes Region).These are the first recommendations developed for décrue sorghum in the Sahel.

Incubation Center Model- The food processing project created the "Incubation Center" model for making sorghum and millet processors more competitive and to grow markets for small holder farmers. The Incubation center model established at IER/LTA in Sotuba, was designed to introduce and improve technologies for urban processors and to work with them to strengthen their enterprises. The goal for the Incubation Centre was to make this an interactive facility where local entrepreneurs are trained in new cereal processing technologies, are able to use the equipment to produce product on a limited scale, test the marketplace, bring feedback to the Center for process improvement R&D, and to access investment funds for their own mechanized operations.

Contributions of the Bamako Incubation Center-High quality sorghum flours were produced from advanced food quality sorghum lines and provided to SOADF, the baking school and training center for Mali. It was demonstrated, that with superior quality flours, baked products can be made with 20% sorghum flour incorporation without loss in quality (or discrimination with 100% wheat flour products). We feel this Incubation Centre concept in Mali would work to provide Bamako and smaller urban entrepreneurs' new processing technologies and technical expertise to grow their enterprises and expand the market for sorghum and millet. This concept is successfully working in Senegal and Niger and has resulted in investment in processors.

Food processing entrepreneurship model-The food processing project developed a model of "food processing entrepreneurship" which was designed to mechanize processors (mostly women) and to work with them to grow their enterprises. Chosen from local processor associations, seven women and their respective teams were were financed and constructed structures set to project specifications and their units were supplied with milling equipment to be paid back to the project on the depreciated portion of their equipment. They were trained in technical aspects of processing,

business management and marketing concepts. They were linked to the production-marketing component of the project, and bought clean and quality sourced grains from the nearest farmer group associated with the Production-Marketing Project (J. Sanders). High quality was emphasized and processors saw how consistent, high quality products could be sold well in the market. Packaging was developed to maintain a central brand for these competitive products as produced by the different processors. Due to the curtailing of the project after the coup d'etat, the final activities of introducing a centralized mechanized processing line for agglomerated products (using an "incubation" concept of training and usage) and scaling up of production was not done.

Contributions of Mopti/Gao Processing Project-1) We have shown that mechanized food processing can be successful even in rural areas when introduced with care and when attention is paid to details to assure high quality, competitive products, 2) Even though the project terminated in March 2012, due to the coup, IER continued working with the women entrepreneur processors and they have continued their business activities in Mopti and three of the four have paid their installments as per their contracts into the fall 2012 and 3) The Mopti/Gao processing project demonstrates a model that works and is market driven and sustainable.

Long term trainees- Five long term trainees participated in the program. The initial four students (Aly Ahamadou, Fatimata Cisse, Mamadou Dembele and Bandiougou Diawara) arrived in Indiana June 2009 and began a six-month custom English language program through the Indiana University Center for Intercultural Communication (ICIC) in Indianapolis. Home stays with English-speaking families were an important part of the program. The final participant, Sory Diallo, arrived in January of 2010 and began his English language training at Kansas State University (KSU). By June 2011, all five participants were accepted into graduate programs with proposed finish dates ranging from June 2012 to December 2013.

Fatimata Cisse, the only female participant, was was admitted to Purdue January 2010 to pursue her Master's in Food Science working with Dr. Bruce Hamaker. Due to her exceptional performance and the potential benefit to Mali/IER, Dr. Hamaker pursued funding support, IER approval and by-pass approval for Cisse to move to a PhD program. Her proposed PhD completion date is May 2014 and at that time she will return to Mali and continue her research at IER in the Bamako Incubation Center.

Bandiougou Diawara was admitted to the KSU Graduate School and began his Master's program in Agronomy at KSU June 2010. Working with Drs. Vara Prasad and Scott Staggenborg, Diawara successfully completed his coursework and thesis research and in June 2012 returned to Mali and his position at IER.

Sory DIALLO was admitted January 2011 to KSU's Graduate School to pursue his Master's in Agronomy. Working with Drs. Prasad and Staggenborg, he completed his coursework and conducted his research in Kansas. He successfully defended his thesis in late August 2012 and then returned to Mali and his position at IER.

Aly Ahamadou and Mamadou Dembele are both pursuing a non-thesis MSc. In June 2012, when USAID suspended support, WTAMU was able to find non GOM funding to support Ahamadou and Dembele, allowing them to remain at WTAMU to complete their degrees. They are scheduled to complete their degrees and return to IER/Mali by December 31, 2012.

Short Term Trainees- Plant breeding trainee Abocar Oumar Toure completed his two month training at Purdue with Dr. Mitch Tuinstra in September 2010. In October 2011, crop production trainee Abdoul Wahab Toure completed his two month training at Kansas State with Drs. Vara and Staggenborg on sorghum and soybean crop physiology and production. Both returned to IER/Mali.

4. Project component description

I. Production-Marketing Project

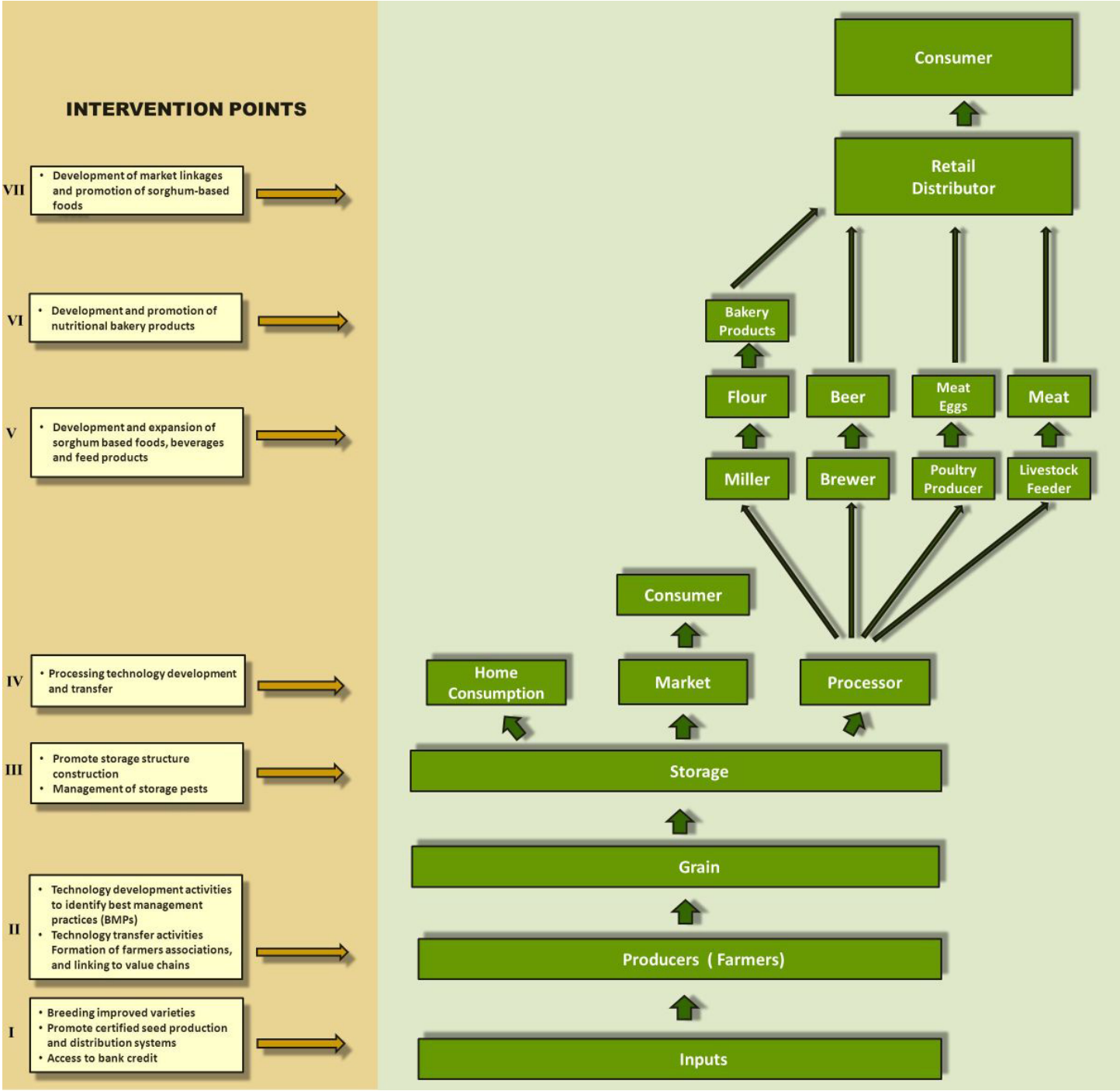
The **production-marketing** activities are led by John Sanders (Purdue University) and Botorou Ouendeba (Consultant/Niger). This activity draws on the expertise of INTSORMIL scientists in its technology development, extension and marketing activities. Activities are conducted in collaboration with the 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.

The team implemented a system including technology introduction, development of farmer groups, marketing strategy innovation, and linking of farmer groups to food and feed processors. The basic premise of this project was that substantial new technologies already exist for these crops. These technologies include new cultivars, moderate inorganic fertilization, and improved agronomic practices. What has been lacking has been a concern with and a strategy to respond to the three principal price collapses reducing the profitability of these basic staples. Prices collapse at harvest as farmers are pressed to make a series of expenditures at that time. Prices collapse in good and sometimes even in normal years as there is just so much of the grain that people can eat so new markets put floors under staple prices. Thus an approach to provide value added products is needed. Finally, governments often intervene in bad rainfall years when prices start going up by providing aid in the form of food or by providing food imports at a subsidized price thus lowering the value of locally grown sorghum and millet. Putting short run consumer interests over those of producers can have a long run deleterious effect on farmers' incentives to use inputs and to make investments in their agricultural activities. So with our marketing strategies we attempt to avoid as many of these price collapses as possible. The consequence is that we increase the profitability of farmers' investments in increased input use. Not using enough inorganic fertilizer is similar to telling poor people that they should eat less. Plant nutrients are essential to any strategy to increase yields.

Our principal intermediate results are to get technologies onto farmers' fields, introduce marketing strategies and develop new farmers' associations. The ultimate objectives are to raise farmers' incomes, develop and extend methods to move technology more quickly from the experiment station to farmers, and facilitate the links of farmers back to the experiment stations so that researchers respond more rapidly to pressing field problems.

We followed a value chain approach in our technology development and transfer activities. A value chain is the recognition that the value of the product is created by the producer (farmer) plus a number of activities along the chain to the consumer. A value chain approach is especially important in reducing poverty and increasing food security of vulnerable groups such as smallholder farmers and female headed households because these groups have the fewest commercial relationships and reap the fewest benefits from their economic activities. The project operates at the following intervention points in the value chain.

Inputs→ II. Producer→ III. Grain storage→ IV. Processor/market/poultry producer→ V. Market expansion→ VI. Retail distributor→ VII. Consumer



Activities at each intervention point

I. Inputs level→

- Seed- Farmers were trained to produce sorghum and millet seed. In 2011 we had an excellent harvest of Grinkan from the farmer seed producers in the Koutiala region with yields around 1.8 t/ha in spite of the late season drought. Once the new cultivar has been introduced in the first year of the program they work with local farmers and the farmers' organization to produce seed for succeeding years in the region. This requires training of local farmers in the principles of isolation and rouging. Rouging is an especially difficult concept because the new improved cultivars are generally of medium height and farmers traditionally select the taller, hardier cultivars which have less grain and

are actually off types. Once farmers understand the concept of selecting for shorter stalks and more grain they areable to make selections and thus produce quality seed.

- Access to bank credit and fertilizer – The project promotes access to bank credit via the formation of farmers' associations. The input credits for the seed and the inorganic fertilizers must be repaid to the farmers' association in grain at harvest.
- Bargaining power to purchase inputs via farmers' associations.
- Another critical input provided is the tarps (baché) to get the threshing off the ground and thereby produce cleaner grain for the processors.

II. Producer level→

This project starts with the farmers getting improved technologies onto their fields. The 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 the project in the delivery of the technologies and the monitoring of the farmers. 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 they also regionally test new cultivars from the national breeders in this process.

III. Storage level→

Promotion of proper grain storage through the construction of storage structures by collaborating NGOs, providing advice on the management of storage pests and by introducing triple layered hermetically sealed bags which control grain storage insects.

IV. Processor/market/home consumption level→

The processing project created the "Incubation Center" model for making sorghum and millet processors more competitive and to grow markets for small holder farmers. The Incubation center model established at IER/LTA in Sotuba, was designed to introduce and improve technologies for urban processors and to work with them to strengthen their enterprises. The goal for the Incubation Centre was to make this an interactive facility where local entrepreneurs are trained in new cereal processing technologies, are able to use the equipment to produce product on a limited scale, test the marketplace, bring feedback to the Center for process improvement R&D, and to access investment funds for their own mechanized operations.

V. Development and market expansion of sorghum-and millet-based foods, beverages and poultry feed level→

The food processing project developed a model of "food processing entrepreneurship" which was designed to mechanize processors and to work with them to grow their enterprises. Chosen from local processor associations, seven women and their teams financed and built structures, set to project specifications, and their units were supplied with milling equipment to produce a variety of high quality grain products for the marketplace. Contracts were signed that included a system to pay back the depreciated portion of their equipment to the project. They were trained in technical aspects of processing, business management, and marketing concepts. They were linked to the production side of the project, and bought clean and quality sourced grains from the nearest farmer group associated with the Production-Marketing Project (J. Sanders'). High quality was emphasized and processors saw how consistent, high quality products could be sold well in the market. Packaging was developed to maintain a central brand for these competitive products as produced by the different processors.

Studies were conducted to determine the potential for using sorghum and millet gain as a poultry feed source. The consumption of poultry products is increasing steadily in Mali and the promotion of sorghum and millet as a feed source should be pursued. Increased demand for poultry feed will encourage increased production by farmers.

VI. Retail distributor level→

Due to the curtailing of the food processing project after the coup d'etat, the final activities of advertising and promotion, introduction of a centralized mechanized processing line for agglomerated products (using an "incubation" concept of training and usage), and scaling up of production, was not done.

II. Décrue Sorghum Project

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, Sotuba and Samba Traore, Agronomist and Director of the Cinzana Research station of IER. Activities were conducted in collaboration with the sorghum program scientists from IER, Sotuba. The goal was to identify agronomic practices that lead to increased yields and increased quality of post water recession grown sorghum. Activities conducted by IER scientists 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 identified suitable technologies to farmers. The global objective was to generate improved agronomic techniques along with appropriate décrue sorghum cultivars to sustain food production and foster economic improvement of rural northern Mali.

III. Food Processing Project

The **Food Processing Project** is led by Prof. Bruce Hamaker of Purdue University. The overall goal of the cereal processing technology and training component of the project is to establish a successful model of entrepreneurial processing of competitive millet and sorghum food products for expansion of the grains in the marketplace. The project is managed out of IER/Sotuba by Yara Kouriessi and the project hired two young food technologists, one located in Sevaré to work with processors in the Mopti/Gao region and one located at IER/Sotuba to work at the Incubation Center. Our cereal processing technology consultant, Mr. Mamadou Diouf, has extensive expertise and experience in sorghum/millet processing and working with entrepreneurs.

Processors in the Mopti/Gao region are now generally functioning in terms of processing milled products that are being sold into the marketplace. We have a full-time food technologist, Niamba Fousseyni, who resides in Sévaré, the adjacent town to Mopti where our entrepreneur partners have their processing units. Niamba has played the critical role of working constantly with the processing units, in Sévaré as well on a monthly basis in Gao.

IV. Training

In Spring 2009, a subcontract for the Mali Training component was awarded to Purdue University with Jess Lowenberg-DeBoer, Director of International Programs in Agriculture, serving as the Principal Investigator and Coordinator. IER identified eight students for training, five for long term academic training and three for short term training. The initial group of long term students included three males and two females, in accordance with the Mission goal of training more women. However, one female participant withdrew when USAID decided young dependents would not be funded and/or allowed to accompany their mothers. IER then identified a replacement candidate to participate. The Five long term will complete their degrees in the USA and return to IER/Mali

5. Achievements

Production – Marketing

John Sanders, Purdue University, Botorou Ouendeba and Mamourou Diourte, IER

Synthesis of Activities and Accomplishments of the Production-Marketing Project of the INTSORMIL Mali, Program, 2008-2012.

USAID/Mali provided financial support for five years (2008-2012) to develop a pilot project with the goal of transferring new technology in sorghum and millet production to farmers and to develop a model that could be scaled up by other agencies. To do this we collaborated with the national agricultural research institution (IER), the national extension organization (DRA) and various NGOs. To evaluate the success of a pilot project it is necessary to evaluate the extent of the scaling up by our collaborators. We also need to assess the qualitative changes in our farmers' groups in relation to yields, prices, incomes and the development of model institutions to insure sustainability. However, prior to doing this we had to first change the popular perceptions regarding millet and sorghum and their roles in the national economy in Mali.

Popular perceptions of millet and sorghum in Mali and for entire Sahel are that they are both regarded as "subsistence crops." To many this implies all or a combination of the following: 1) there is no fertilizer response to these crops, 2) farmers cannot make money from fertilizing these crops, 3) farmers will not fertilize these crops and 3) banks will not lend money to fertilize these crops. In the process of doing this fieldwork we demonstrated that all of this conventional wisdom was untrue. Moreover, the new USAID-Mali program of Feed the Future now includes millet and sorghum as priority crops. Since these are the main crops consumed, demonstrating the potential of these crops for higher yields, incomes, and market expansion may be our most important contribution.

The program started slowly with 420 ha in 2008 (Tables 1 and 2) but in this year we finally found an excellent sorghum cultivar, Grinkan. With average yields of 1.5 tons/ha and the best farmers getting over 2 tons/ha in Garasso we were very excited as was USAID/Mali. Based on this success the USAID program was substantially expanded both financially and time wise (four years) and added a food processing component, an agronomy component on "decrue" sorghum and a training component in 2009. In 2009 we again had excellent yields of Grinkan in Garasso of 1.9 tons/ha for 150 ha and the farmers' association sold 105 tons of sorghum that year. Also we improved in our effort of getting farmers to clean their millet and sell it to millet processors at a premium price of 15 to 20 CFA/kg more than the price of unclean millet. Farmers also received a higher price for selling later rather than at harvest so our project farmers in Tingoni received up to 50 CFA/kg more than farmers selling unclean millet. So the marketing strategy we employed for millet at our project sites was showing a significant payoff.

In 2010 USAID /Mali asked us to support IICEM in scaling up our Production-Marketing Project. Thus, we supported both AMEDD and Global 2000 in working with IICEM. When IICEM did not finance the fertilizer for Global 2000 in 2010 as planned we stepped in and provided the fertilizer and thus increased our project coverage area under new technolologies by almost 500 additional ha. Meanwhile, in the north the response to inorganic fertilizer was good in 2009 but the seed quality arranged by DRA was poor. Hence, in 2010 we obtained certified seed of Toroniou for the Mopti region and we began getting average yields 1.2 t/ha for the millet with moderate fertilization. In 2010 we facilitated the scaling up of IICEM in Koutiala and Mopti by providing certified millet seed for that program and directly collaborated with Global 2000 in getting out 494 ha (Table 2) under our project.

Both the IICEM and Global 2000 projects had some differences from our original program. Both brought in directly the banks and that was a very useful addition as it demonstrated that the banks could be involved even though the farmers did not have collateral (communal land ownership predominates).This was the last of the four elements of conventional wisdom needing to be disproved. Given the differences in the scaling up and our pilot program we wanted to keep extending our pilot program to make sure that the scaling up modifications were not as large as to be disruptive to the success of our program. On the scaling up IICEM claimed 3,000 ha in the new technologies 2010 and Global 2000

(also with IICEM) with our help had 494 ha. In 2010 we had 1476 ha (982 ha excluding the 494 of Global 2000) in our pilot program project area.

In 2011 we expanded substantially our program in Mopti as farmers had very good millet yields. Note that with the high rainfall and flooding 2010 was an adverse year for sorghum as it is planted on the heavier soils and in the lowlands. However, millet is planted on the slopes and plateaus and on the lighter soils so with the high rainfall millet yields were excellent at up to 1.5 tons/ha average. So we expanded substantially in the millet zones especially in Mopti in 2011 but also again in the Segou region with another 500 ha with Global 2000 (partial support-just for fertilization).In the south with the late rains the mold-insect complex substantially damaged Grinkan in the field during 2011 which lead to very low germination rates in the seed plots. Hence, in 2011 in the south we stopped our extension program and concentrated on seed production. We also advised IICEM about this problem. In 2011 we had an excellent harvest of Grinkan from the farmer seed producers in the Koutiala region with yields around 1.8 t/ha in spite of the late season drought.[1] This was also the year that our Mopti millet producers negotiated hard and received more than 200 CFA/kg for their millet when the normal year price would be between 90 to 110 CFA/kg.

In 2012 we had the improved Grinkan seed and expanded our program in the Koutiala region by 680 ha including 150 ha in Garasso. We also substantially expanded our Mopti activities by 740 ha plus the 120 ha in our old reliable site of Tingoni. So our total area in 2012 of new and continuing sites was 1,860.[2] IICEM was planning 5,000 ha in the Koutiala and Mopti regions. We helped them by providing 4 tons of excellent Grinkan seeds for Koutiala. So in the final year there was both a substantial scaling up and a large extension of our pilot project area.

The following is a summary of our accomplishments.

- A demonstration that our model could substantially increase yields, prices and incomes. [3]
- A new extension model of village level activity was demonstrated as previous demonstration trials have generally been unsuccessful with cereals in the Sahelian countries.
- The integration of the technical extension and the marketing aspects of the project are critical to be able to finance the additional inputs needed to overcome the soil fertility constraints.
- Demonstration of the income gains from clean millet, selling later in the year when prices rebound, finding new markets, especially millet food processors, and later in the marketing chain, village or local town merchants and by increasing the bargaining power of farmers through group sales and input purchases via the farmers' associations.
- Success of the new IER developed cultivar Grinkan in Mali (with us 680 ha and with IICEM 2,000 to 3,000 ha in 2012). The cultivar has also been introduced with excellent results in Burkina Faso and Niger.
- Substantial scaling up in 2010-2012 by IICEM and Global 2000 of our technology-marketing-institution model with a 5,000 ha goal of IICEM in 2012.
- Knowledge that improved sorghum technology is rapidly adopted and that subsequent farm household income increases by 20 percent. Most of this income effect is triggered by the yield effect led by the sorghum technology (improved cultivar, moderate inorganic fertilizer and improved agronomy).
- Development of model villages in the different regions, which are very well known. Garasso in Koutiala, Tingoni in Segou, and Kountogoro in Mopti.
- Millet and sorghum are included as priority crops in the Feed the Future program of Mali.
- Modifying the project work plans to make sure that women have control of the output from their plots.[4]

[1] These farmers planted early and fertilized so the sorghum was better able to resist the late season drought than most farmers.

[2] This did not include the continued participation of up to 1,000 ha in the Segou region where we only counted new areas in 2010 and 2011.We did not go back to estimate these continuing areas as USAID-Mali asked us to focus on the south and Mopti in 2012.

[3] We also published annual reports of these parameters in bulletins.

[4] Women have access to only very small land areas so it was clarified that the beneficiaries of the womens' plots were to be women. Women were allowed to just have small areas in the program that they controlled and separate farmers' associations for women were implemented.

Post script: It is going to be very hard to continue this scaling up program through the contracting of consulting agencies as they are not sufficiently familiar with the technical and economic problems that can occur. For example, the seed problem was serious in 2011 and there will be other biological and economic problems. The most important concept is to simultaneously improve extension of the complete package (moderate fertilization, an improved cultivar, good seed, a water retention technique and improved agronomy) and to improve the marketing through a farmers' association. This is a lot of pieces to be assembled in order to achieve success.

Table 1. New project sites and continuing area (ha) under improved sorghum cultivation and associated technologies from 2008 to 2012 in Mali.

Project sites			Area (ha) under sorghum cultivation					Total
	Regions	Improved Sorghum varieties	2008	2009	2010	2011	2012	
Kafara	Koulikoro	Niatichama	50	100	0	0	0	**150**
Diola	Koulikoro	Niatichama	50	100	0	0	0	**150**
Garasso, Koutiala	Sikasso	Grinkan	50	150	117	120	150	**587**
Kaniko, Koutiala	Sikasso	Niatichama, Grinkan	50	50	0	0	0	**100**
Zanzoni, Koutiala	Sikasso	Niatichama	0	50	0	0	0	**50**
Finkoloni, Koutiala	Sikasso	Niatichama	50	0	0	0	0	**50**
Seed Prod., Koutiala	Sikasso	Grinkan				20		**20**
Extension, Koutiala	Sikasso	Grinkan	0	0	0	0	530*	**530**
Kolokani	Kouliokoro	Seguifa	50	100	100	100	100	**450**
Diankounte Camara	Kayes	Seguifa	0	50	75	0	0	**125**
Katiena	Segou	Seguifa	0	50	100	100	100	**350**
Beleco	Koulikoro	Tiandougou	0	0	0	60	60	**120**
Kita	Kayes	Tiandougou coura	0	0	0	60	60	**120**

Sadiola	Kayes	Tiandougou	0	0	50	0	0	**50**
		Total	**300**	**650**	**442**	**460**	**1000**	**2852**

**Obtained from Bougouna Sogoba, AMEDD. For the extension with all inputs there were 680 new ha of which 150 were in Koutiala. There was also Grinkan seed distributed without the full input package. We do not include that area where we only provided seed in the above.*
Source: Adapted from Mamourou Diourte, **Transfer of Sorghum, Millet Production, Processing and Marketing Technologies in Mali,** draft report for INTSORMIL, October 2012.

Table 2. Project sites and continuing area (ha) in Toroniou millet cultivation and associated technologies from 2008 to 2012 in Mali

Communes	Villages	Number of storage units supported	Areas (ha)					Total
			2008	2009	2010	2011	2012	
Petaka	Oualo	2		60	120	180	180	**540**
Kanibonzon	Kanikombolé	1		-	60	80	20	**160**
	Sadia	1		-		60	120	**180**
Koro	Téré	1		-	60	80	120	**260**
	Pomorododiou -Bégné	1		-		60	120	**180**
Koporo-Nah	Kountogoro	2		-	60	120	180	**360**
Pel	Témégolo	1		-		60	120	**180**
	Pissa	0		60	60	-	-	**120**
Petaka	Mougui	0		-	60	-	-	**60**
Segou	Tingoni	0	120	150	120	120	120	**630**
Segou-Global 2000[5]					494	500	5	**999**
TOTAL		**9**	**120**	**270**	**1034**	**1260**	**865**	**3549**

Note: In collaboration with Global 2000 and partial financing from Production-Marketing the millet technology area was expanded 494 ha in 13 farmers associations in 2010 and another 500 ha with 17 new farmers' associations in 2011. Global 2000 provided the technical inputs, monitoring and some of the financing of these Segou area sites of Toroniou.
Source: Adapted from Mamourou Diourte, **Transfer of Sorghum, Millet Production, Processing and Marketing Technologies in Mali,** draft report for INTSORMIL, October 2012.

[5] Of the 994 new ha in 2010 and 2011 in the collaborative program with Global 2000 we expect continuity into 2012 but we do not have any data on this so have not included this. This would substantially increase the estimates for 2011 and 2012

Agricultural Diversification Strategy: Role of Sorghum
(Summary of J. Coulibaly PhD dissertation) ***http://intsormil.org/smscientificpubs/JeanneCoulibalyPhDDissertation.pdf***

Mali has experienced significant increases in area and productivity of the main cereal crops over the past ten years. While production of the cereal sector has been increasing the cotton sector has been through a period of drastic decline. There is now evidence that an agricultural diversification strategy is needed to sustain farmers' income and help them to cope with the declining prices in the world cotton market. Hence, questions are raised about the choice of investment strategies between restoring the cotton sector and/or diversifying into the cereals that can be most successful in enhancing farmers' income. Though past policy initiatives have put a greater emphasis on improving maize productivity, sorghum offers a stronger comparative advantage to maize outside the high rainfall areas. Sorghum better tolerates flood, drought and soil nutrient deficiencies than maize. So, sorghum can help farm households secure enough food for consumption and can represent a source of cash income.

In the objective of providing alternative source of income for farmers and raising traditional sorghum productivity, we evaluated the effects of the introduction of sorghum agricultural technologies with the present access to the fertilizer subsidy and marketing strategies. The model results reveal that the improved sorghum technology is rapidly adopted. Farm household income increases by 20 percent. Most of this income effect is triggered by the yield effect led by the sorghum technology (improved cultivar, moderate inorganic fertilizer and improved agronomy).

These results indicate that the improved sorghum technology is a viable source of revenue diversification when farmers have access to improved cultivars, fertilizers, and input credit. The farmers' associations facilitate all these things. Storage and late selling will ultimately lead to lower prices as more farmers embrace these strategies. Then other marketing activities will need to establish new markets such as the use of sorghum in poultry feed substituting for maize. Meanwhile, a focus on rapid technology expansion appears to have higher returns than the storage investments for the improved marketing.

The bottom line here is that new sorghum technologies and marketing facilitate the diversification away from cotton and will be expected to continue but at a slower rate even as the fertilizer subsidies are eliminated. Sorghum plays a very important role in smoothing the household income over time when the cotton price is reduced and the fertilizer subsidy is eliminated. So, there is a danger of not recognizing the potential of sorghum by only providing the fertilizer subsidy to cotton and maize as was the case before 2011. Continued training of farmers' associations in marketing strategy and business management should enable them to further improve output prices and to prepare for the real price declining effect expected from the widespread introduction of the late selling of sorghum. Higher sorghum prices are presently obtained through storage and late sales. In the future a demand expansion for sorghum stimulated by the development of the emerging animal feed processing industry for the poultry industry is expected to be effective in moderating a price decline from widespread technology introduction. Also, large product sales and volume input purchases by farmers' associations will also benefit farmers.

Further, fertilizer subsidies are deemed fundamental for Mali to increase crop productivity, meet the food security challenges and contribute to fulfill the goal of transforming Mali into the regional cereals granary for the sub-Saharan region of Africa consistently with the Malian Agricultural Plans. Strengthening the farmers' association ability to access and to modify fertilizer recommendations over time is one way of getting the costs of fertilizer down. The farmers' associations can buy fertilizer in large quantities thereby reducing costs. Also as investments in infrastructure take place the cost of transport and other transaction costs related to long distance between the farm production entity and input and product markets will also be reduced. Continuing research and extension will also be useful to support the diversification activities and develop site specific fertilizer recommendations.

Production-Marketing Exit Strategy

The following four principal activities were planned for the last year of the project. However, due to the coup most were not accomplished. Hopefully IER or some other USAID supported agency can complete these activities so as to increase the impact of our efforts in Mali.

Promoting the Grinkan variety and associated technologies so that they become firmly established in the Koutiala "cercle." - Grinkan (sorghum) is an excellent cultivar. We have demonstrated high yields and excellent profits in high,

normal and low rainfall years. We have also introduced a marketing strategy especially geared to take advantage of the substantial price increases in adverse rainfall years. Now the primary scaling up is being done by IICEM but we are still demonstrating the importance of farmers' associations, on farm grain storage, careful observance of the agronomic recommendations and setting up a quality seed production system. Since Grinkan is subject like most caudatums to problems with late rains (mold-insect complex with consequent germination problems the next year), seed production is especially important as well as the agronomic training on planting time. In 2012 we have the improved seed we produced in 2011 and plan to put Grinkan on 500 to 750 ha in the summer of 2012 as well as supplying IICEM for some of their seed requirements. With this base and 10 to 13 new farmers' associations and several field days our technical training for IICEM, AMEDD and a core of farmers' associations will be finished. We expect Grinkan to then take off in a rapid diffusion process in the Koutiala cercle. Seed production will need to be regularly renewed and we are continuing our work on facilitating this system in 2012. The BNDA and other banks will also be more interested in providing input and inventory credit ("warrantage") loans for Grinkan and associated technologies. This will give a boost to IER where Grinkan was developed and will encourage the continued production of new technologies for this region by IER as well as increased farmer interest in them.

Maintaining momentum in the Mopti region with the introduction of millet production technology and grain storage on a wider scale- In seven farmers' associations we have partially financed the storage facilities in 2011. Most of these associations now have completed their storage facilities. We plan to add 380 to 500 ha (adding three more farmers' associations and increasing membership in the others) in this region again by supplementing the IICEM scaling up activities but making sure that the model also includes farmers' associations, improved marketing practices and regular access to quality seed. The rapid scaling up of the IICEM program makes it difficult to get all the pieces together to maintain high profit levels, sustainability and ownership of the process by IER and DRA. In 2012, through activities of the Production-Marketing Project we will have introduced over 1,000 ha with these new systems. In the future, even better millet cultivars will be more rapidly introduced as the farmers' associations will have been widely diffused in the principal production regions of Mopti so we are again passing over the system to IER and DRA for continuation.

Seed production in Koutiala and Mopti- With small farmers' associations of seed producers we are enabling the emergence of a new group of entrepreneurs to practice quality control and traceability techniques necessary in the seed industry. They are also putting pressure on existing seed producers to extend more activities into millet and sorghum. An IER scientist collaborating with us is taking the lead on this and should be able to continue progress in this area after 2012.

Publications - We have revised and will publish our "fiche technique" that describes the agronomic, marketing and farming system recommendations for the new technologies and this will be widely distributed. We also continue to prepare other publications on economic aspects of the project including the farm level impact on yields, prices, profits, reimbursement rates and confidence of the members in their farmers' associations. A PhD thesis was recently completed at Purdue on the farm level impact of Grinkan (http://intsormil.org/smscientificpublications.htm

Package of Practices for Sorghum and Millet

FICHE DE PRODUCTION ET DE COMMERCIALISATION DU SORGHO, MALI

MARS 2011

FRENCH VERSION

(SEE ANNEX FOR THE TEXT)

Variété GRINKAN à maturité, Garasso, Mali, 2010

SORGHUM PRODUCTION MANUAL FOR SOUTHERN MALI

BAMBARA VERSION

(SEE ANNEX FOR TEXT)

FICHE DE PRODUCTION ET DE COMMERCIALISATION DU MIL, MALI

BOTOROU OUENDEBA, INTSORMIL; NIABA TEME, IER ET L'EQUIPE DE IICEM

AVRIL, 2011

FRENCH VERSION

(SEE ANNEX FOR TEXT)

FICHE DE PRODUCTION ET DE COMMERCIALIZATION DU MIL

Dogon version of the Millet Production Manual for Northern Mali

(See Annex for text)

FICHE DE PRODUCTION ET DE COMMERCIALIZATION DU SORGHO

Bambara version of the Sorghum Production Manual for Northern Mali

(See Annex for text)

Food Processing Technology

Bruce Hamaker and Fatima Cissé, Purdue; Mamourou Diourte, IER; Yara Koreissi, IER/LTA; Mamadou Diouff, Consultant

I. Summary

The food processing technology activities were led by Dr. Bruce Hamaker (Purdue University) and Mr. Mamadou Diouf (Consultant/Senegal), a former leader of the FAO initiative PROCELOS working with food processor groups, and a food technologist with the Institut de Technologie Alimentaire, ITA, Dakar and the following collaborators from IER, Mali: Mme Dembélé Yara Koreissi and Dr Mamourou Diourté. The overall goal of the cereal processing technology component of the project was "*to establish a successful model of entrepreneurial sorghum/millet processing so as to expand markets for millet/sorghum through high and consistent quality market-competitive processed products*." The objectives were 1) enterprise development by training entrepreneurial processors in the Mopti-Gao Regions in technology-based improvements, 2) providing technology support for urban processors by establishing an incubation center in the Bamako area, 3) linking with the Production-Marketing Project to contract farmers for grain supplies and 4) promoting access to local, urban and regional markets.

The processing project consisted of two major components: 1) mechanization of entrepreneurial processor partners in the Mopti/Gao area and 2) development of a Malian entrepreneur processor Incubation Centre at IER/LTA Sotuba. For both activities, the aim was to create models to improve the competitiveness of small and medium-scale food processors in the region and to drive expansion of markets for local farmers. The design of these models is rooted in their being sustainable, producing high quality processed sorghum and millet-based food products and creating successful enterprises that depend on quality raw commodities bought (with premiums attached) from local farmers or farmer organizations.

Year 1 activities focused on organization of the project, strengthening the IER Food Technology unit, and identifying processors to work with, preferably in the Mopti area. Year 2 and 3 activities focused on purchasing, installing and fixing processing equipment on one hand and setting up the processing units to meet requirements and training, on the second hand. Year 4 and 5 activities concentrated on the development of the incubator concept and continued support of the entrepreneurial units. Several workshops were held to introduce and demonstrate new technologies for processing millet- and sorghum-based agglomerated products (*couscous* of different particle sizes, *dégué*, *moni curu*) using high through put technologies developed at Institut d'Technologie Alimentaire (ITA) in Dakar (with whom we have worked for many years). The objective of the workshops was to introduce millet and sorghum processors and INTSORMIL's partners (IICEM processor partners) to new processing technologies to strengthen their ability to process market competitive sorghum and millet foods and to increase the quality and value of their product. Beneficiaries were INTSORMIL collaborators from Gao, Mopti and Bandiagara and the local processor association AMTCL/ Bamako, and partners from IICEM millet and sorghum processors project. INTSORMIL as well as IICEM provided support to their partners and also to other participants.

Principal Investigator, Bruce Hamaker, Purdue University, with food processing entrepreneurs at a workshop

II. Component 1 –Mopti/Gao region entrepreneur partners

The major strategy as outlined in the original INTSORMIL proposal was to mechanize processors in the northern areas of Mopti and Gao and to work with them to grow their enterprises. Chosen from local processor associations, seven women and their teams financed and built structures set to project specifications and their units were supplied with milling equipment to produce a variety of high quality grain products for the marketplace. Contracts were signed that included a system to pay back the depreciated portion of their equipment to the project. They were trained in technical aspects of processing, business management, and marketing concepts. They were linked to the production side of the project, and bought clean and quality sourced grains from the nearest farmer group associated with J. Sanders' project. High quality was emphasized and processors saw how consistent, high quality products could be sold in the market. Packaging was developed to maintain a central brand for these competitive products as produced by the different processors. Due to the curtailing of the project after the coup d'etat, the final activities of advertising and promotion, introduction of a centralized mechanized processing line for agglomerated products (using an "incubation" concept of training and usage), and scaling up of production, was not done. The Gao project was stopped at this time, however the Mopti project continued.

Processors in the Mopti/Gao region are now generally functioning in terms of processing milled products that are being sold into the marketplace. We have a full-time food technologist, Niamba Fousseyni, who resides in Sévaré, the adjacent town to Mopti where our entrepreneur partners have their processing units. Niamba has played the critical role of working constantly with the processing units, in Sévaré as well on a monthly basis in Gao.

Entrepreneurs in Gao, Mopti, Sevaré and Bandiagara have been trained on the use of processing equipment and how to operate and maintain the machines before and after each processing run and how to follow/document the production of the processing units. Grain was purchased from farmers working with the team of the production-marketing project in Koutiala, Douentza and N'Garasso. Generally, quality was good for the processing units and further purchases have been sought. Two aspects of quality of grain are important to the processors to make high quality products, grain cleanliness and homogeneity of grain size. The latter factor affects ability to decorticate grains evenly and make high quality flours both for direct sale and for processing to other products. We have developed a system to document the activities of the food processors in each unit to follow amount and types of products produced. Diversity of products, many of which require an expertise and precision beyond their training, shows an identification of markets by the entrepreneurial partners. Communication from processors to farmers is important and has been established from the production-marketing project to build sustaining links between these two players in the supply chain.

III. Contributions of Mopti/Gao Processing Project

- Mechanized food processing can be successful even in rural areas when introduced with care and attention is paid to details to assure high quality, competitive products.
- Even though the project stopped in March 2012, because our partner was the GOM IER, women entrepreneur processors have continued their business in Mopti and three of the four have paid their installments as per their contracts into the fall 2012.
- The Mopti/Gao processing project demonstrates a model that works and is market driven and sustainable.

IV. Component 2 - IER/LTA Incubation Center

In Bamako at IER/LTA in Sotuba, the project established an Incubation Center that was formally launched in fall 2011. This was designed to introduce and improve technologies for urban processors and to work with them to strengthen their enterprises. Our goal for the Incubation Centre was to make this an interactive facility where local entrepreneurs are trained in new cereal processing technologies, are able to use the equipment to produce products on a limited scale, test the marketplace, bring feedback to the Center for process improvement R&D, and to access investment funds for their own mechanized operations.

The Incubation Center building and milling and agglomeration and drying equipment was fully functional in June 2011. Thus we conducted a demonstration and training workshop for Bamako area processors and our Mopti/Gao entrepreneur partners. It was emphasized that success for the project will be assessed by demonstration of a sustaining successful model where entrepreneurs are able to process grains into high and consistent quality products that have good and continuing sales in the marketplace, and where grain purchases are made from farmers or farmer's groups that supply high quality grains to processors**.** Over the summer quarter, final items were completed for the formal Octoberl launch of the Center. Also during this time, equipment was tested and procedures were further developed for processing of products. We identified two Bamako area processors to work with and have installed two processing equipment pieces in these two units, with a repayment scheme similar to that used with the Mopti/Gao entrepreneurs. Since the inauguration we have demonstrated the functioning of the Incubation Center in providing technical support and further process refinement with processors for processing of quality competitive products.

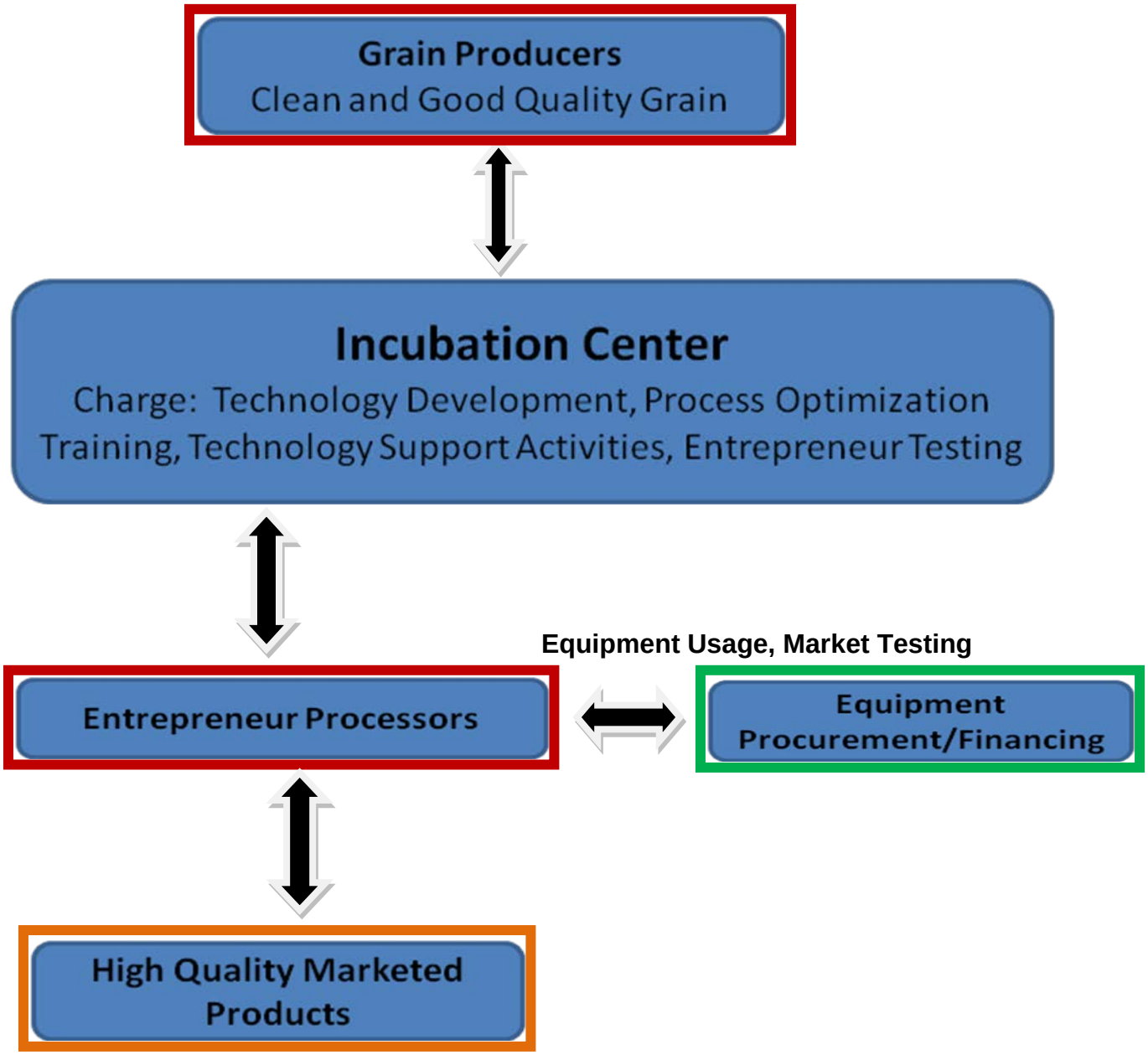
Work was continued at the Incubation Centre to produce high quality sorghum flours that can be used by Bamako bakeries. Through this project conducted in collaboration with IICEM quality grain was identified and decortication and milling conditions were determined to process excellent quality flour. Work on the new mechanized couscous/degué agglomerated processing line has progressed well.

V. Incubation Center Model

The result of the component 2 activities has resulted in the development of an Incubation Center Model. This model is described in the two figures below.

IER/LTA Incubation Center

Technology-Driven Process Development



Incubation Center Model

PURDUE UNIVERSITY

PURDUE AGRICULTURE

Entrepreneurship

"Incubation Center Model"

Mechanized equipment

Services at the Center

- Training
  - Technical /business skills
  - Process demonstrations
  - Testing learned skills with oversight
- Exceptional support
  - Business and market consultation
  - Equipment repair
  - Facility use and market testing
- Optimized product output
  - Continuous R&D
  - Scale-up support
- Farmer organizations – link to the value-chain

VI. Contributions of the Bamako Incubation Center

- Though the Incubation Centre was officially opened and functioning only ~6 months before the coup, it had (and has) high visibility and interest among local processors.
- High quality sorghum flours were produced from advanced food quality sorghum lines and provided to SOADF, the baking school and training center for Mali. It was demonstrated, that with superior quality flours, baked products can be made with 20% sorghum flour incorporation without loss in quality (or discrimination with 100% wheat flour products). With IICEM, we had planned an expansion of this effort to demonstrate how the right decortications/flour technology can make composite flours work, with appropriate equipment and training to millers. This effort was curtailed in March 2012.
- We feel this Incubation Center concept in Mali would work to provide Bamako, and smaller urban, entrepreneurs new processing technologies and technical expertise to grow their enterprises, and expand the market for sorghum and millet. This concept is working in Senegal and Niger and has resulted in investment in processors.
- Ms. Fatima Cisse, graduate student trainee on this project, conducted a study in Bamako showing that traditional sorghum and millet foods (thick porridges and *couscous*) deliver energy to individuals over a substantially longer time than "modern" staples (rice, potatoes, wheat pasta). This is due to their effect of slowing stomach emptying time, which was quantified in the study. This knowledge of the healthy aspects of sorghum and millet foods could be used in a campaign to promote higher consumption in urban areas.

VII. Food Processing Exit Strategy

The following principal activites were planned for the last year of the project. However, due to the coup most of the activities were not accomplished. Hopefully IER will continue the development of the incubation center and working with the food processing entrepreneurial groups.

For the Mopti/Gao region processing project, our goal is to have profitable processing units functioning in both Mopti and Gao. Currently, the majority of the units are functioning and we will during the remaining project period 1) work with processors to better link to high quality grain sources through the Production/Marketing project, 2) make

available one more cost-effective technology as part of the IER Incubation Center activities (this equipment will not be placed in the entrepreneurial processing units, but entrepreneurs will be trained and have access to it), and 3) work to promote processed products for markets. Our strategy at this point is to focus solely on improving the capacity and competitiveness of the functioning units. The overall goal of this part of the project has been and continues to be to create a successful model of processing technology dissemination that expands markets for farmers. We hope that on completion of the project, that processing units will be functioning in a sustainable way, and that this may form the basis for introducing processing technologies for mechanization of food processing units in other regions.

At IER/Sotuba, we have established a cereal processing Incubation Center that expands the incubator concept to serve not only as a training and technology dissemination center, but a unit that supports private sector processors with continuous product and technology improvement. It also provides an important function of being a technology disseminator to regional areas of Mali, including those in the FtF program. Concurrent with the establishment of the Incubation Center in the Laboratoire du Technologies Alimentaire (LTA) at IER has been a commitment to its use and function. In the final period of the project, we will work to find ways for the Incubation Center to have some income generating potential, perhaps through renting of facilities, processing of high quality products for certain select markets, and fee for service workshops and training.

Décrue Sorghum

Vara Prasad, Coodinator, Kansas State University, Mamourou Diourté, Sorghum Program Leader, IER, Abdoul Wahab, Touré, sorghum agronomist IER, Dr. Niaba Témé, sorghum breeder, IER and Abdoulaye G. Diallo, breeder, IER, Sotuba, Mali

I. Backgound

Sorghum grown in the receding water (décrue) production system is important for food security in northern Mali. There is no documentation of research either on genotypes or crop management practices on décrue sorghum production systems. The décrue sorghum project was initiated in 2007 with the first exploratory visit occurring in 2008. During this first trip, Lake Faguibine was the focus of the research. Lake Faguibine is located in the Tombouctu region in what is commonly referred to as "the North" by Malians. During this initial trip, we engaged sorghum farmers from several villages in order to better understand the cropping systems and develop future research and outreach activities. During the first year, field plots were established near two villages in the Lake Faguibine area. The objectives were to evaluate pest management strategies, soil fertility needs, and local cultivar evaluation. Results from the first year were very positive and several high yielding local sorghum varieties were identified as well as some basic management strategies developed. In 2009, the efforts were expanded to include other areas in the North. Additional villages were identified in the other lakes. The result of these efforts culminated in engagement of several NGOs to assist us in expanding activities in farmers' fields. Due to security issues in northern region since 2010, décrue research and outreach activities were limited in the extreme north, but were expanded in Mopti and Kayes areas. Training and education activities included both short term and long term training in Mali and Kansas State University (KSU).

II. Summary

The **décrue sorghum** activities are led by Vara Prasad, Kansas State University, in collaboration with the sorghum program scientists from IER, Sotuba: Mamourou Diourté, Sorghum Program Leader and in country coordinator, IER, Sotuba, Abdoul Wahab, Touré**,** sorghum agronomist IER, Sotuba, Dr Niaba Témé, sorghum breeder and Abdoulaye G

Diallo, breeder, IER, Sotuba. The goal is to identify agronomic practices that lead to increased yields and increased quality of post water recession grown sorghum. Activities conducted by IER scientists 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. A survey of the pest constraints in décrue sorghum was conducted by IER scientists Dr. Moussa NOUSSOUROU, Dr DIARISSO Niamoye YARO and Dr. Mamourou Diourté and West Texas A&M entomologist Dr Bonnie Pendleton. Based on the research results obtained and observations in this project a package of practices was developed for décrue sorghum in the North (Tombouctou and Mopti Regions) and in the South (Kayes Region). Project results are detailed below.

III. Cultivar evaluationand selection

From a preliminary screening of 50 cultivars tested in Gao (in the décrue area), in Mopti (on station) and Kayes (décrue area) as based on the participative approach, the following genotypes were selected by farmers: Saba Sôto Koreye, Saba Albakari , Saba Sôto Kara, Saba Sôtô Tienda, 05-SB-DU-135, 05-SB-DU-119, CSM 63 and 08-KO-DU-111. Among the cultivars selected by farmers, Saba Sôtô, Saba Tienda and Niatichama were the highest yielding. Saba Sôtô and Saba Tienda have been selected as the most promising cultivars for the décrue system because of their yields and preferences by women for threshing and food purposes. However, both lack sufficient grain quality and thus IER is crossing Saba Sôtô and Saba Tienda with cultivars reported to have excellent grain quality. The third generation of improvement has been completed.

The demonstration plots showed superior adaptability of varieties Saba Soto and Saba Tienda when compared to Niatichama in the décrue production systems in northern regions of Mali (Tombouctu). Niatichama, although its grain quality is well appreciated by women, appeared to be less adapted to the décrue system, compared to Saba Sôtô and Saba Tienda, the local cultivars. There is a need to test more genotypes for yield stability and grain quality in this region. Farmers in most regions showed interest in producing Saba Soto or Saba Tienda. Prior to the coup we were in the process of developing a seed production system for these two genotypes.

IV. Cultivar development recommendations for décrue sorghum

Objectives	Expected results	Activities	Findings	Recommendations
To identify performing cultivars for sustainable production of sorghum in the decrue system using participative approach	At least one performing cultivar is identified for sustainable production of sorghum in the décrue system.	Identification of suitable cultivars for sustainable production of sorghum in the décrue system	1.1 Among the seven cultivars selected over thirty three by farmers, Saba Sôtô, Saba Tienda and Niatichama were the most high yielding ones (2008 result) 1.2 Niatichama, although its grain quality well appreciated by women, appeared to be less adapted to the décrue system of Goundam due to its lateness (2009 results).	To cross Saba Tienda with an earlier genotype having higher yield and better grain quality. To cross Saba Sôtô with an earlier genotype having a better grain quality.

			1.3 Niatichama was found very sensitive to honey dew while Saba Sôtô appeared to be a very tolerant cultivar to that problem	To cross Saba Sôtô with introduced genotypes having higher yield, better grain quality and earliness to tackle the honey dew (aphid) problem.
			1.4 Demonstration plots in Gao and Tombouctou showed not only a lesser stability of Niatichama, but also earliness of Homa Koare (a local one from Bya, in Gao region).	1.4.1 To remove Niatichama from the list of genotypes to be used in the decrue area. 1.4.2 To proceed to seed purification of Saba Sôtô and Saba Tienda and to their respective seed production.
			1.5 From a preliminary screening of cultivars based on participative approach, the following genotypes were selected by farmers in 2009: Saba Sôto Koreye, Saba Albakari , Saba Sôto Kara**,** Saba Sôtô Tienda,05-SB-DU-135, 05-SB-DU-119, CSM 63, 08-KO-DU-111	1.5.1 Submit to lab analysis, selected genotypes for grain quality purpose.

V. Crop management practices

- Increasing plant density (decreasing plant spacing) showed yield benefits across the regions. These yield benefits were mostly related to a greater number of productive tillers and improved resource utilization.
- The response of sorghum to fertilizer depended upon the soil type and location. Fertilizer management studies showed positive responses in a few sites (Lake Horo) where nutrients N and P were found to be deficient. There was a limited or no response in some sites (particularly Lake Faguibine). More research is needed in the highlands. There is a need to critically evaluate décrue soil for nutrients and identify regions where fertilizer management can form part of the management package. In addition to nitrogen, some regions were deficient in phosphorus, thus both should also form the part of the management package. There is a need for soil testing prior to planting to determine the benefits of inorganic fertilizer. In addition, more research is needed in the highlands which generally have poor soils.

VI. Sorghum yield when following the Integrated Crop Management Package of Practices

Our research has shown that use of integrated package of adapted genotypes (e.g. Saba Soto, Saba Tienda, Saba Albakari) seeds treated with fungicide and planted at a spacing of 0.8 x 0.6 m, with a fertilizer application of (Urea or DAP) will improve grain yield by >30% across most décrue sites.

VII. Plant Protection Activities

Plant Protection in Décrue Sorghum

Moussa NOUSSOUROU, DIARISSO Niamoye YARO, Mamourou Diourté and Bonnie Pendleton

Objective of visits to décrue sorghum sites

To survey the pest situation and to develop strategies to be used in the management of décrue pests which are threats to sorghum in the various experiments conducted in the lake region.

Activities

1. Survey of farmers' perceptions of pests in décrue sorghum

Through focus group interviews and discussions at different lakes, farmers' perceptions were collected and grouped into categories of constraints which represented their concerns regarding pests on décrue sorghum crops

2. Knowledge of pests and diseases and related natural enemy biodiversity

Through visual observations and plant samples and pest specimens collected from sorghum plants in the seedling stage to maturity and other host plants and useful information on the prevalence and abundance of décrue pests and hosts plants was obtained.

3. Training of technicians in pest identification and management strategies

Results

- The survey participants consisted of producers (farmers) and extension agents and their perception of décrue sorghum pests at the lakes Télé, Horo and Faguibine during the planting period in April 2011
- According to the extension agent (Boiré 2006 and 2007) the main constraints are rodents, birds and insects. Among the insects, aphids and soil insects are the most damaging. Diseases and weeds were also mentioned.
- Bird nest destruction by children is frequently practiced from July to October to reduce bird populations.
- Farmers ranked the constraints as follows: 1) aphids, 2) soil insects, 3) caterpillars, 4) crickets (grasshoppers) 5) termites, 6) diseases, 7) birds and 8) weeds. They thought that a plant *Calotropus procera* (known commonly as apple of Sodom and has reported medicinal properties- the milky sap contains a complex mix of chemicals, some of which are steroidal heart poisons known as "cardiac aglycones") is an alternate host of aphids and when animals feed on aphid infested plants they would die.
- During the monitoring trip many pests and a natural enemies (larvae feed on pests) e.g. *Allograpta* sp. (hover flies) were noticed. The pests observed included aphids, soil beetles and weeds. No pesticides were used to control them. The alternate host *C. procera* was heavily infested with aphids at all three lakes, so its role as an alternate host should be investigated. Plant regrowth of *C. procera* was found everywhere in the lake and could be the source of infestation.
- In September 2011 another monitoring trip was conducted at the three lakes. Several crops were checked for presence or absence of pests. The most dominant crops in term of hectarage were sorghum, rice, millet and cowpea. At the lakes Télé, Horo, Faguibine and Fati, insects, mites, rodents, birds and diseases were found attacking sorghum. Twenty five sorghum plots were monitored and insects found on sorghum included the stalk borers (*Busseola fusca* and *Chilo sp.*) and the blister beetle, *Cylindrothorax westermanni* (Meloidae) which feeds on the sorghum plant. The percent damage by the stalk borer on different sorghum cultivars is mentioned in the table below. Percent damage was very high reaching 60% at Télé. Sorghum cultivar Saba Soto had lower damage than cultivar Saba Tienda.

Stalk borer damage estimates on sorghum cultivars in lakes Télé, Faguibine and Horo, September 2011

Lakes	Cultivars	Plots number	Total tillers checked	Number of tillers damaged	% damage
Télé	Saba soto	3	60	22	37
	Saba tienda	3	60	37	60
Faguibine	Saba soto	2	40	17	43
	Saba tienda	2	40	23	58
	Saba beri	1	20	11	55
Horo	Saba soto	3	60	16	27
	Saba tienda	3	60	21	35

During the September 2011 monitoring trip stalk borer damage in millet plots was also estimated. Damage was high but generally less than in sorghum plots (see table).

Stalk borer damage estimates in millet plots in lake Télé, Faguibine and Horo, September 2011

Lakes	Plot numbers	Total tillers checked	Number of tillers damaged	% damage
Télé	3	60	7	12
Faguibine	3	60	20	30
Horo	2	40	9	23

On June, 29-30, 2011, at Sotuba, technicians and extension agents were trained on insect collecting and removal from traps and plants, scouting for damage ratings, sample taking and insect specimen preparation for identification. The good pest identification would allow the proper management of the pests to reduce the damage. About 20 participants attended the session. They also receive some guide lines on disease identification.

Knowledge of pests and diseases and related natural enemy biodiversity

The two monitoring trips in April and September gave some baseline information about the pest status in the décrue area. But the pest population dynamics data should be collected year around to give more information about a pest status to come up with the best management tactics. Also knowledge of pests and diseases and related natural enemy biodiversity in décrue sorghum should be further implemented.

VIII. Packages of practices developed for décrue sorghum

Package of Practices for Décrue Sorghum: North (Tombouctou and Mopti Regions) and South (Kayes Region)

Characteristics of Recommended Décrue Sorghum Varieties for Northern Mali

IDENTIFIED ADAPTED VARIETIES AND THEIR CHARACTERISTICS							
Varieties	Planting to flowering (days)	Planting to maturity (days)	Drought	Sensitivity to disease	Honey dew	Yield potential (kg/ha)	
						Grain	Forage
Saba Sôtô (23)	98-100	128	Less sensitive	Less sensitive	Resistant	1,800-3,300	14,000-21,000
Saba Tienda (28)	101-108	128-134	Sensitive	Very sensitive	Very sensitive	400-1,600	7,000-24,000

Sources : TOURE, A.W. (2009) ; TOURE, A. W. (2010)

CULTURAL PRACTICES								
Cropping system	**Yield target kg/ha**	**Soil tillage**	**Seed treatments**	**Seed rates**	**Time for planting**	**Required fertilizer**	**Inter and intra-row spacing**	**Plant population (plants per ha)**
CS3: Sorghum intercropping with cowpea, with grain production of sorghum and forage production of cowpea	Cowpea: 500-1,000 (forage)		Use of fungicide and insecticide on both sorghum and cowpea seeds	20-25 kg per ha for cowpea	Cowpea: 2-3 weeks after planting and weeding sorghum	Nutrients left to soil after water retreats	Cowpea: 1.60 m x 0.80m for cowpea row: sorghum 2 plants per hill ; 1 row of cowpea within 2 rows of sorghum for forage production of cowpea	Cowpea: 7,500 hills per ha and 15,000 plants per ha of cowpea
CS4: Corn intercropping with sorghum, with grain production of both crops and forage production of corn	Corn: 1,500 kg/ha	No tillage or plowing at 10-15 cm depth using hand hoes depending on the time of water retreat	Use of fungicide and insecticide on both corn and sorghum seeds	20-25 kg per ha for corn	Corn: January to February	Nutrients left to soil after water retreats	Corn: 1.60m x 0.40m (2 plants per hill)	15,500 hills per ha 31,000 plants per ha
CS4: Corn intercropping with sorghum, with grain production of both crops and forage production of corn	Sorghum: 1,000 kg/ha			8-10 kg per ha for sorghum	Sorghum: 3-4 weeks after planting corn	Nutrients left to soil after water retreats	Sorghum: 1.60m x 0.60m (3 plants per hill)	10,000 hills per ha 30,000 plants per ha

Recommended Décrue Sorghum Technologies for Southern Mali (Kayes Region)

Yield targets (Kg/Ha)		Agro-climatic zones	Annual rainfall (mm)	Expected duration of rainy season (in days)	Varieties	Planting to maturity (days)	Planting dates	Treatment	Seed rates	Soil tillage	Required fertilizer	Plant geometry	Plant population (plants per ha)
Grain	Stover												
2,360-3,780	11,417-19,695	Guinean zone	1200 mm	150 days	Tiandougoucoura and similar improved caudatum varieties	125-130	25 June to 10 July	Use of fungicide and insecticide as indicated by the manufacture	8-10 kg per ha	Plowing at 15-20 cm depth to incorporate green manure developed during May and June	56N, 61P2O5, 15K2O, 4S Depending on soil types and previous crops and cropping systems	0.75 m x 0.25 m 2-3 plants per hole	100,000 - 150,000
		South Sudanian	800-1100 mm	90-110 days	Tiandougoucoura and similar improved caudatum varieties	125-130	15 June to 30 June	Use of fungicide and insecticide as indicated by the manufacture	8-10 kg per ha	Plowing at 15-20 cm depth	56N 61P2O5 15K2O 4S depending on soil types and previous crops and cropping systems	0.75 m x 0.25 m 2-3 plants per hole	100,000 - 150,000

Yield targets (Kg/Ha)		Agro-climatic zones	Annual rainfall (mm)	Expected duration of rainy season (in days)	Varieties	Planting to maturity (days)	Planting dates	Treatment	Seed rates	Soil tillage	Required fertilizer	Plant geometry	Plant population (plants per ha)
Grain	Stover												
		North Sudanian	600- 800 mm	50-60 days	Tiandougoucoura and similar caudatum varieties	125- 130	20 June to 05 July	Use of fungicide and insecticide as indicated by the manufacture	8-10 kg per ha	Plowing at 15-20 cm depth	56N, 61P2O5, 15K2O, 4S Depending on soil types and previous crops and cropping systems	0.75 m x 0.50 m 2-3 plants per hole	80 000 - 100 000
2,410-4,190	9,000-13,861	Guinean zone	1200 mm	150 days	Niatichama and similar improved caudatum varieties	120-125	25 June to 10 July	Use of fungicide and insecticide as indicated by the manufacture	8-10 kg per ha	Plowing at 15-20 cm depth to incorporate green manure developed during May and June	71N, 76P2O5, 30K2O, 8S depending on soil types and previous crops	0.75 m x 0.25 m 2-3 plants per hole	100,000 - 150,000
		South Sudanian	800-1100 mm	90-110 days	Niatichama and similar improved caudatum varieties	125	25 June to 10 July	Use of fungicide and insecticide as indicated by the manufacture	8-10 kg per ha	Plowing at 15-20 cm depth to incorporate green manure developed during May and June	71N 76P2O5 30K2O 8S	0.75 m x 0.25 m	100,000 - 150,000

Yield targets (Kg/Ha)		Agro-climatic zones	Annual rainfall (mm)	Expected duration of rainy season (in days)	Varieties	Planting to maturity (days)	Planting dates	Treatment	Seed rates	Soil tillage	Required fertilizer	Plant geometry	Plant population (plants per ha)
Grain	Stover												
											Depending on soil types and previous crops and cropping systems	2-3 plants per hole	
		North Sudanian	600 – 800 mm	50-60 days	Niatichama and similar improved caudatum varieties	125	25 June to 10 July	Use of fungicide and insecticide as indicated by the manufacture	8-10 kg per ha	Plowing at 15-20 cm depth	56N, 61P2O5, 15K2O, 4S	0.75 m x 0.50 m	80,000 - 100,000
											Depending on soil types and previous crops and cropping systems	2-3 plants per hole	
2,109-3,541	11,056-17,500	Guinean zone	1200 mm	150 days	Séguifa and similar improved caudatum varieties	100-117	20 July to 30 July	Use of fungicide	8-10 kg per ha	Plowing at 15-20 cm depth to incorporate green manure developed during May and June	71N 76P2O5 30K2O 8S	0.75 m x 0.25 m	100,000 - 150,000
								and insecticide as indicated by the manufacture			depending on soil types and previous crops and cropping systems	2-3 plants per hole	

Yield targets (Kg/Ha)		Agro-climatic zones	Annual rainfall (mm)	Expected duration of rainy season (in days)	Varieties	Planting to maturity (days)	Planting dates	Treatment	Seed rates	Soil tillage	Required fertilizer	Plant geometry	Plant population (plants per ha)
Grain	Stover												
		South Sudanian	800-1100 mm	90-110 days	Séguifa and similar improved caudatum varieties	100-117	15 to 30 July	Use of fungicide and insecticide as indicated by the manufacture	8-10 kg per ha	Plowing at 15-20 cm depth to incorporate green manure developed during May and June	71N, 76P2O5, 30K2O, 8S	0.75 m x 0.25 m	100,000 - 150,000
											Depending on soil types and previous crops and cropping systems	2-3 plants per hole	
		North Sudanian	600-800 mm	50-60 days	Séguifa and similar improved caudatum varieties	100-117	10 to 30 July	Use of fungicide and insecticide as indicated by the manufacture	8-10 kg per ha	Plowing at 15-20 cm depth	56N, 61P2O5, 15K2O, 4S	0.75 m x 0.50 m	80,000 - 100,000
											Depending on soil types and previous crops and cropping systems	2-3 plants per hole	

IX. Décrue Sorghum Exit Strategy

The following principal activites were planned for the last year of the project. However, due to the coup most were not accomplished. Hopefully IER can complete these activities, especially the publication and the dissemination of the recommended packages of practices (in local languages) that we developed) so as to increase the impact of our efforts in Northern Mali.

Technology development (research), rather than technology transfer (extension) was emphasized in the initial years of this project because no published information regarding crop management practices was available and thus there was no technology to transfer to farmers. Based on our research activities we now have more knowledge of the system and a better understanding of genotypes, constraints and crop management practices which can significantly improve productivity and income. Our studies have primarily been conducted in décrue farmers' fields so it should be easier to transfer the new technologies to farmers via farmers as they learn from each other. During this year (2012) we will work with the Production-Marketing scientists in the development of farmer organizations and increase the acreage under our recommended package of practices which are location specific for Mopti, Timbuktu Gao and Kayes (see in this report) with emphasis on the Feed the Future regions. During this last year we will continue needed research activities which are coordinated by an IER scientist Abdoul Wahab Toure and we will encourage IER to continue the promising research activities and disseminate the promising practices to décrue farmers beyond 2012.

IER capacity for conducting relevant research needed to develop an improved package of practices has been strengthened through our capacity building activities. We have been building the capacity by short term and long term training of IER scientists (two IER students graduated from KSU in 2012). These two graduate students will likely be posted in the northern region (Mopti, Gao or Timbuktu). They have been trained on several research and extension activities. Thus, by September 30, 2012 we will make the transition to IER and our local partners to continue the décrue sorghum activities. We have provided IER and other partners with the necessary information so that they can continue to have an impact in the décrue regions of Mali.

X. Conclusions

This is the most comprehensive research and technology transfer project conducted on décrue sorghum in the Sahel. Previous activities by the French in the 1990s consisted primarily of planning workshops and the preparation of an extensive document, "*La Culture du sorghum de décrue en Afrique de l'Ouest et du Centre: Situation actuelle et définition d'un Plan d'Action Régional."* Unfortunately, the French left West Africa and this plan was never put into action. We reviewed this document in developing our plan of work for the Décrue Sorghum Project and have for the first time developed a package of practices for the production of décrue sorghum in the North and the South, Mali. Now it is up to IER, DRA and other agencies to transfer this technology to farmers. The Package of Practices should be translated into the local languages and develop into content for transfer to farmers via radio, cell phones and other novel ICT media.

Training

Jess Lowenberg-DeBoer, Purdue University

I. Background

In Spring 2009, a subcontract for the Mali Training Component was awarded to Purdue University with Jess Lowenberg-DeBoer, Director of International Programs in Agriculture, serving as the Principal Investigator and Coordinator. IER identified eight students for training, five for long term academic training and three for short term training. The initial group of long term students included three males and two females, in accordance with the Mission goal of training more women. However, one female participant withdrew when USAID decided young dependents

would not be funded and/or allowed to accompany their mothers. IER then identified a replacement candidate to participate.

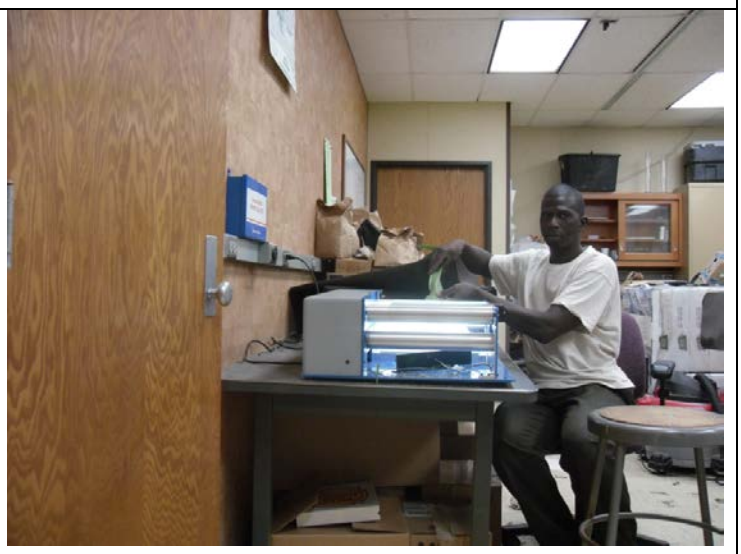
The initial four students (Aly Ahamadou, Fatimata Cisse, Mamadou Dembele and Bandiougou Diawara) arrived in Indiana June 2009 and began a six-month custom English language program through the Indiana University Center for Intercultural Communication (ICIC) in Indianapolis. Home stays with English-speaking families was an important part of the program – so each student lived with a host English-speaking family. The final participant, Sory Diallo, arrived in January of 2010, began his English language training at Kansas State University (KSU) and was admitted to their Graduate School to pursue his Master's in Agronomy in January 2011. By June 2011, all five participants were accepted into graduate programs with proposed finish dates ranging from June 2012 to December 2013.
In April 2012, the USG suspended funding support for the Government of Mali including all Mali funded organizations and institutions in response to the March 21st military coup. This suspension impacted the funding for the five long term students. USAID notified the ME that after the Spring semester the students could no longer be supported by USAID funds. USAID Mali said the students would have to return to Mali without finishing their programs, unless "other" funding could be located to complete their programs. This option was a great relief to Purdue and the students. Non-government funding was secured for all finishing after June 2012. Consequently all five students have or will be able to complete their training before returning to Mali and continue their positions at IER.

II. Long Term Trainees

Fatimata Cisse, the only female participant, was the first to meet the TOEFL requirement and was admitted to Purdue January 2010 to pursue her Master's in Food Science working with Dr. Bruce Hamaker. She performed very well in her coursework and traveled to Mali the summer of 2011 to conduct her research for her theses titled Implications of African Traditional Foods on Gastric Emptying and Satiety. Due to research delays, her program end date was pushed back to August or December 2012. In June 2012, when USAID suspended support, Purdue/Hamaker was able to secure "other" funding allowing Cisse to move off of USAID funds and remain at Purdue. Due to her exceptional performance and the potential benefit to Mali/IER, Dr. Hamaker pursued funding support, IER approval and by-pass approval for Cisse to move to a PhD program. Her proposed PhD completion date is May 2014 and at that time she will return to Mali and continue her research at IER.

Bandiougou Diawara was the next participant to meet the TOEFL requirement. After completing one semester of the English Language Program (ELP) at KSU he was admitted to the Graduate School and began his Master's program in Agronomy at KSU June 2010. Working with Drs. Vara Prasad and Scott Staggenborg, Diawara successfully completed his coursework and research on the effect of planting rate on growth and development of grain sorghum.
Mr. Diawara worked on his research project and at the same time taking academic classes. The main objectives of his thesis research were (a) to understand the impact of early planting on growth and yield of sorghum and (b) to understand response of selected sorghum hybrids to early planting. In June 2012, he finished his theses and returned to Mali and his position at IER.

Bandiougou Diawara in field at Manhattan



Bandiougou Diawara conducting leaf area analyses with a leaf area meter

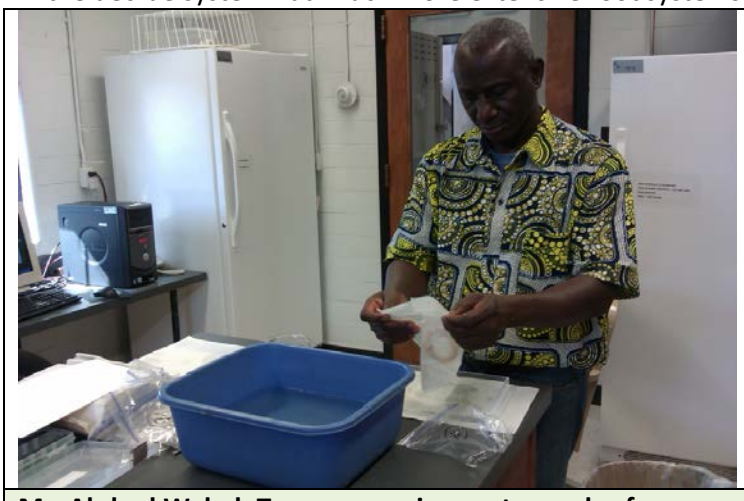
Sory DIALLO, arrived at Kansas State University January 2010 and began his English language training at KSU through their English Language Program (ELP). After completing two semesters of ELP, Diallo was admitted January 2011 to KSU's Graduate School to pursue his Master's in Agronomy. Working with Drs. Prasad and Staggenborg, he completed his coursework and conducted his quality trait analyses on grain research in Kansas. After the USAID funding suspension in June 2012, KSU was able to secure "other" funding, allowing Diallo to stay at KSU and complete his Master's theses that summer. He successfully defended his theses in late August and then returned to Mali and his position at IER.

Mr. DIALLO conducted field studies to understand the effect of nitrogen on grain quality of different sorghum genotypes. The objectives of his research were (a) to determine the effect of different levels of nitrogen application (0, 40, and 80 kg ha^{-1}) on grain quality of sorghum; and (b) to evaluate grain traits: kernel hardness, kernel mold, starch content and crude protein content across the sorghum diversity panel. In this study different levels of nitrogen (0, 40, and 80 kg ha-1) are being examined. In summer 2010, a two-year study was initiated to determine the effect of nitrogen levels on grain quality of sorghum. The field experiment was conducted in Kansas, Manhattan, Ottawa, and Hays in 2010 and the same experiment was planted in summer 2011. Treatments consisted of twelve genotypes (six sorghum hybrids and six sorghum inbred lines) and three fertilizer levels (0, 40, 80 kg ha^{-1} with the N fertilizer urea). Experiment was laid out as a randomized complete block design with four replications. At maturity the central four rows of each plot were harvested and threshed separately for obtaining the data of grain yield and grain quality analysis. The grain samples of 2010 experiment are currently being analyzed for grain quality at USDA laboratory. The focus is on kernel weight, kernel crude protein content, kernel hardness and diameter. The results of the experiment from this summer (2011) are currently being analyzed.

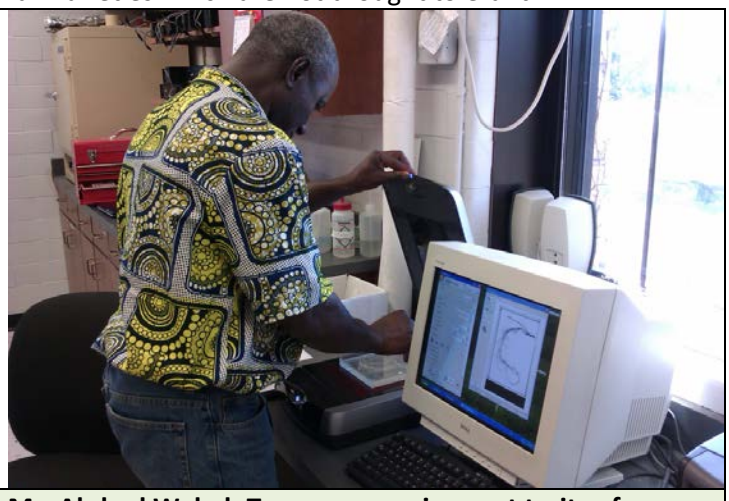
Graduate student Mr. Sory Diallo in his sorghum field at Manhattan

Mr. Sory Diallo establishing field plots in Kansas.

Abdoul Wahab Toure was a research scholar in crop physiology and production laboratory at Kansas State University August – September, 2011. He participated in ongoing field research activities on sorghum and soybean. He also initiated a controlled environment research experiment to understand the root growth of various crops including the sorghum genotypes from the décrue region in Mali. The objectives of his research were (a) to assess differences between crop species based on root parameters; and (b) to assess differences within crop species based on root parameters. Different crop species involved sorghum, corn, wheat and millet under full irrigation and drought stress condition. These experiments are set in controlled environment conditions in green houses. There were two experiments, the first to be harvested after two weeks of stress and quantify effects during early seedling stages; and second experiments to see the effects at late vegetative or reproductive stages of crop development. The first experiment was harvested in late September and data was collected on root traits using root scanner and WinRhizo software. Significant results were obtained. Varieties Saba Soto and Saba Tienda which do well under drought conditions in the décrue system had much more extensive root systems than varieties which are not drought tolerant.



Mr. Abdoul Wahab Toure preparing root samples for scanning.



Mr. Abdoul Wahab Toure measuring root traits of sorghum plants

Aly Ahamadou and Mamadou Dembele, students pursuing Agricultural Economics, struggled to attain the needed English language skills for graduate work. They met the required TOEFL score in May 2011, after two semesters of the English as a Second Language-International (ESLI) program at West Texas A & M University (WTAMU). In June 2011,

they were admitted to WTAMU's Graduate School to pursue a non-thesis Master's degree in Business and Economics in the Department of Agricultural Sciences under Dr. Lal Almas. They presented their research paper titled "Water use efficiency and maximizing profitability of grain sorghum production in the Texas Panhandle" at the Southern Agricultural Economics Association 44th Annual Meeting held in Birmingham, Alabama in February 4-7, 2012. In June 2012, when USAID suspended support, WTAMU was able to find "other" funding to support Ahamadou and Dembele, allowing them to remain at WTAMU to complete their Master's. They are on track to complete their Master's by December 31, 2012 and will then be ready to return to Mali and their positions at IER. The source of funding for their return airfare is under discussion.

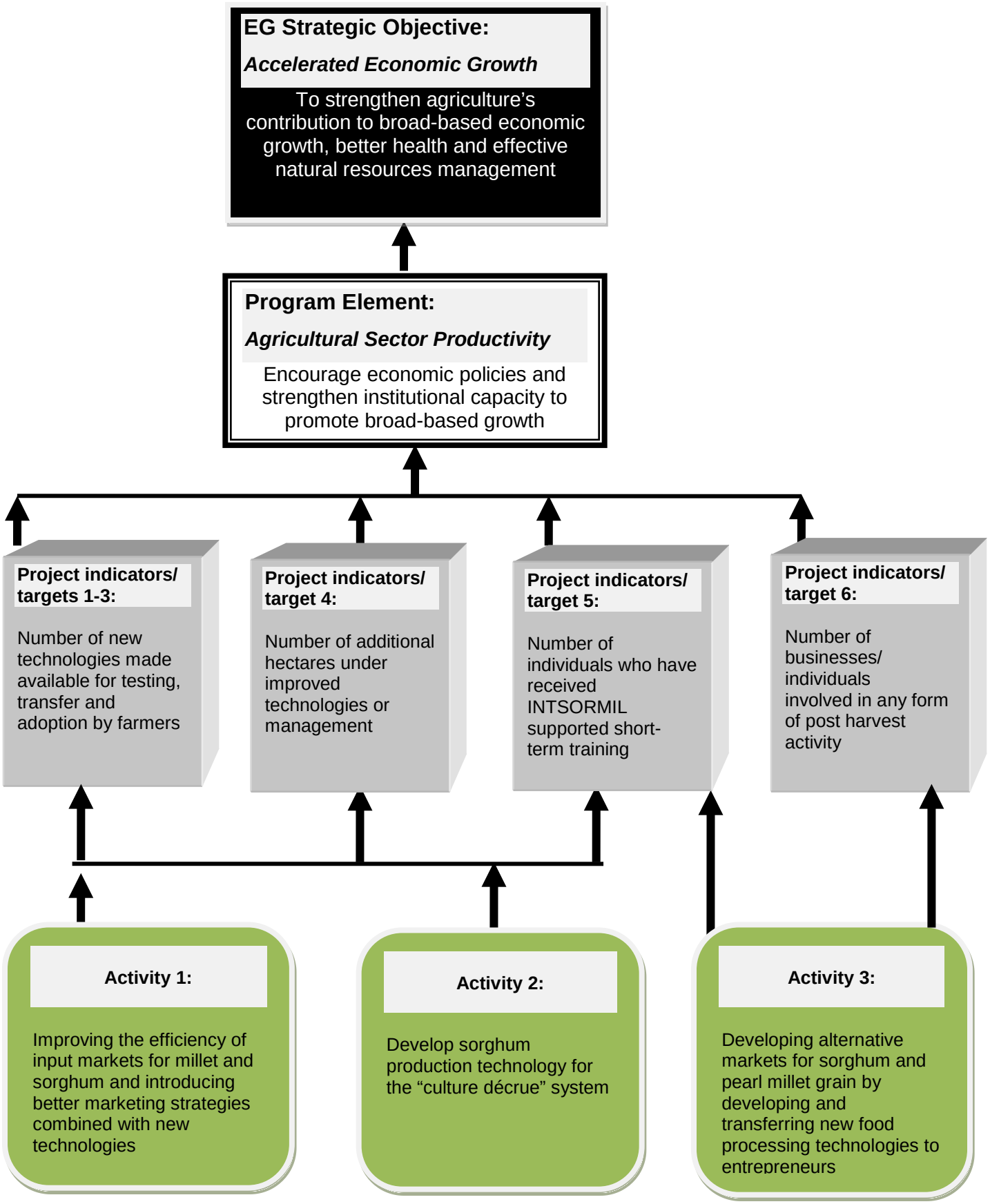
III. Short Term Trainees

Initially, three IER researchers were proposed to complete two-month training programs at Purdue or Kansas State in the areas of plant breeding, agronomy and agricultural economics. Plant breeding trainee Abocar Oumar Toure completed his two month training at Purdue with Dr. Mitch Tuinstra in September 2010. In October 2011, crop production trainee Abdoul Wahab Toure completed his two month training at Kansas State with Drs. Vara and Staggenborg on sorghum and soybean crop physiology and production. A final trainee candidate in agricultural economics was never identified by IER, so the third short term training was cancelled.

IV. US university and faculty support

We commend the strong university and faculty commitment to the Mali Training component which was evident this past year when the political situation in Mali resulted in USAID's suspension of GOM support. The US faculty/universities worked quickly to secure "other" funding and move the students out of USAID funded status in TraiNet to University funded status. As a result, the capacity building goal will be reached as all five students will complete their advance degrees before returning to Mali.

6. Indicators


EG Strategic Objective:
Accelerated Economic Growth
To strengthen agriculture's contribution to broad-based economic growth, better health and effective natural resources management
Program Element:
Agricultural Sector Productivity
Encourage economic policies and strengthen institutional capacity to promote broad-based growth
Project indicators/ targets 1-3:
Number of new technologies made available for testing, transfer and adoption by farmers
Project indicators/ target 4:
Number of additional hectares under improved technologies or management
Project indicators/ target 5:
Number of individuals who have received INTSORMIL supported short-term training
Project indicators/ target 6:
Number of businesses/ individuals involved in any form of post harvest activity
Activity 1:
Improving the efficiency of input markets for millet and sorghum and introducing better marketing strategies combined with new technologies
Activity 2:
Develop sorghum production technology for the "culture décrue" system
Activity 3:
Developing alternative markets for sorghum and pearl millet grain by developing and transferring new food processing technologies to entrepreneurs

How these indicators and targets lead to achievement of the EG strategic objective, Accelerated Economic Growth:

The (1) activities, (2) project indicators and targets and the (3) program element all lead directly to the achievement of the strategic objective, "*to strengthen agriculture's contribution to broad-based economic growth, better health and effective natural resources management.*"

Activity 1 is the main focus of the Production-Marketing project. In 2009 there were numerous successes in southern Mali especially in the Koutiala region with the sorghum cultivar Grinkan and in the Segou region with the millet cultivar Toroniou as we extended our cultivated area to almost 1,000 in the pilot project phase. In 2010 we collaborated with IICEM in scaling up our operation. IICEM became responsible for the implementation and financing of this scaling up of our model activities. Production-Marketing and Processing are the technical advisers to this development project of IICEM. In 2010 the combined effort reached almost 2,500 ha. We are discussing a major increase in 2011.

Activity 2 offers applied research and extension support for a potentially important production activity in the northern region and in the Kayes region. In 2011 this project will work more in combination with the Production-Marketing project as both extend their activities into Kayes. Décrue sorghum has substantial potential for increasing farmers' incomes and welfare and has been largely ignored in the past.

Activity 3 has two important components. Production-Marketing will continue to do market studies of millet food processing and the intensive poultry sectors (for sorghum substitution for maize in the ration). Moreover, we will facilitate ties between these markets and our farmers' associations with workshops and with training to the farmers' associations in marketing arrangements. The Food Processing project is providing mentoring and machinery to several millet processing entrepreneurs in the northern region. With the machinery Food Processing sets up incubator or model processing operations, which a larger sector of new processors can imitate.

Re: 2012 Indicators
Project title: Transfer of Sorghum, Millet Production, Processing and Marketing Technologies in Mali
Leader with Associates Award: EPP-A-00-06-00016-00
Submitted by: Management Entity, Sorghum, Millet and Other Grains CRSP (INTSORMIL) 11/ 20/2012
E A Heinrichs, eheinrichs2@unl.edu

Indicator/ Disaggregation	Deviation Narrative	Comment	Baseline Value 2010	2012 Target PPR	2012 Target Actual 2012 Updated	2013 Target PPR
4.5.2(2): Number of hectares under improved technologies or management practices as a result of USG assistance (disaggregation by: Technology Type, (crop genetics), New/Continuing, Sex)	**+24%** Through their sub-grantee AMEDD and the assistance of the Direction Regional Agricol (DRA), INTSORMIL was able to distribute seed and needed inputs early in the year, allowing for a more than expected response. INTSORMIL's approach is based on storage of grain at the farm level in order to receive higher prices later in the season, allowing them to purchase needed inputs prior to the start of the growing season.		894	1,500	**Total= 1860** New =960 Continuing= 900 Male= 1,700 ha Female= 160 ha	NA
4.5.2(5): Number of farmers and others who have applied new technologies or management practices as a result of USG assistance (disaggregation by: New/Continuing, Sex)	**+17%** Only 160 ha were under the control of women, with each woman receiving approximately 0.25 ha resulting in a higher than expected number of women participants (640) even though the total hectares under their control are relatively small.		1,150	2,000	**Total = 2,330** New= 1,230 Continuing= 1,100 Male= 1,690 Female= 640	NA
4.5.2(6): Number of individuals who have received USG supported long-term agricultural sector productivity or food security		Two have returned and three are currently on non-USAID funding.	5	5	**Total= 5** Male = 4 Female= 1	NA

Indicator/ Disaggregation	Deviation Narrative	Comment	Baseline Value 2010	2012 Target		2013 Target
				PPR	Actual 2012 Updated	PPR
training(disaggregation by: Sex)						
4.5.2(7): Number of individuals who have received USG supported short-term agricultural sector productivity or food security training(disaggregation by: Type of Individual, Sex)	**-54%** INTSORMIL activities were suspended on April 2, 2012 following the coup of March 22, 2012, and did not receive permission to continue activities until July 23, 2012. The unsuspension of activities was further complicated by restrictions on partnering with GOM entities. This suspension occurred at a critical time just prior to the 2012 planting season. The timing and duration of the suspension and the subsequent limitations on program implementation hindered INTSORMIL's ability to carry out planned training activities, resulting in the less than expected results**.** .		1,150	2000	**Total= 923** Male= 653 Female= 270	NA
4.5.2(11): Number of food security private enterprises (for profit), **producers organizations,** water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance(disaggregation by:	**-67%** The suspension of activities prior to the 2012 planting season limited the ability of INTSORMIL to engage new farmers in targeted regions. However, new farmer cooperatives were added in the Koutiala region where we had previously stopped activities in 2011 as a result of seed quality issues. A number of former partner farmer cooperatives were dropped as INTSORMIL focused only on those farmer cooperatives within the Feed the Future zone of influence.		32	110	**Total= 36** New= 21 Continuing= 15	NA

Indicator/ Disaggregation	Deviation Narrative	Comment	Baseline Value 2010	2012 Target		2013 Target
				PPR	Actual 2012 Updated	PPR
Type of Organization, New/Continuing)						
4.5.2(13): Number of rural households benefiting directly from USG interventions(disaggregation by: New/Continuing, Gendered Household Type)	**+13%** INTSORMIL works primarily with rural households to increase their production through improved technology. As a result all participants come from rural households. However, information on disaggregation between household types was not collected and often both the male and female household member participated in the program. To avoid double counting it is assumed that all of the 640 women participants were included in the households of the male participants. Women participants would generally have control over a smaller but separate piece of land upon which they implemented the technics and technologies promoted by INTSORMIL.		750	1,500	**Total = 1,690** New= 896 Continuing= 794 Male= 1,690 Female=640	NA
4.5.2(14): Number of vulnerable households benefiting directly from USG interventions(disaggregation by: New/Continuing, Gendered Household Type)	**+13%** Sorghum and millet in Mali are viewed as food security crops grown primarily to serve the needs of the household, and grown on marginal lands with poor soil fertility and no irrigation system. By definition, households engaged in sorghum and millet production are vulnerable and have been included under this indicator. Only through improved cultivars and agricultural inputs, better agronomic practices and		750	1,500	**Total = 1,690** New= 896 Continuing= 794 Male= 1,690	NA

Indicator/ Disaggregation	Deviation Narrative	Comment	Baseline Value 2010	2012 Target		2013 Target
				PPR	Actual 2012 Updated	PPR
	proper post-harvest handling is sorghum and millet being seen as a potential source of revenue.					
4.5.2(39): Number of new technologies or management practices in one of the following phases of development: Phase I Under research Phase II Under field testing Phase III Available to transfer to farmers	**0%** **+17%** One new millet variety was made available	 Décrue Sorghum and food processing projects All projects Note that in the Production -Marketing project the technology package was essentially the same except for differences in cultivars.	17 6 6 5	16 None given None given 6	**Total all phases= 16** Phase I: Under research= **4** Phase II: Under field testing=**5** Phase III: Transferred to farmers= **7**	NA

7. Gender Related Achievements

I. Jeanne Coulibaly dissertation

http://intsormil.org/smscientificpubs/JeanneCoulibalyPhDDissertation.pdf

DIVERSIFICATION OR COTTON RECOVERY IN THE MALIAN COTTON ZONE: EFFECTS ON HOUSEHOLDS AND WOMEN

Jeanne Yekeleya Coulibaly

Presented to the Purdue University Graduate School 12/05/2011

Summary

The welfare estimation of the various agricultural policies adopted at the household level shows that women are made better off from the increased household income. However, less labor intensive technologies such as the agricultural sorghum and marketing technologies provide a larger net income to women than policies to revamp the cotton sector. Policy initiatives that are less labor intensive allow for greater gains for women by enabling women to invest more labor time into the opportunity that maximizes their private income, i.e. their personal plot. With the challenges facing women on access to land in terms of quantity and quality and also access to agricultural inputs, policy interventions for the private plot may need to target first access to better lands, compost and transportation.

To increase women's income, other alternatives to the non-farm activities and to the private plot might be found in increasing the share of household income paid to women. Even though small, women receive a share of the household profit. With the new avenues for increasing household income and the bargaining type of decision making, there will be increasing pressure on the household head to raise the share of the income surplus from new technologies and marketing paid to women. Also, another strategy to increase women's welfare that was beyond the scope of analysis in this research is to reduce women's labor burden from the unpaid household chores. This could be made possible through access to household labor saving technologies in order to generate efficiency of women's time and release time opportunities for self-employment or income generating activities.

Greater control of women's output can be achieved from strengthening their negotiation power, for example through the gender groups. In the Mopti region of Mali, the IER-INTSORMIL program has been successful at helping women to benefit from the new millet technologies by convincing their husbands to allow women to have access to a portion of the lands. Women work individually but create marketing groups to share the productivity gains. An alternative to the concentration on the private plot is to raise the compensations received from the family plot. A second alternative to increase women's income is the release of women's time from the labor intensive farm activities and unpaid household chores. The release of time from the labor intensive farm activities will be made possible with diffusion of agricultural technologies that require less investment in labor such as cereal technologies. The duty of fetching water, firewood, and traditional processing of grains for meals all consume tremendous amount of time. So, household labor saving technologies including motorized water pumps, improved stoves and grain mills are expected to be effective in relieving women from the domestic work burden and create opportunities for productive activities. Additional free time will enable women to engage in non-farming activities where they can have extra source of cash.

II. Gender related achievements and how gender is mainstreamed into the activities- The land holding system in the Sahel is that the extended family farms together a communal area with the household head making the decisions on labor supply and product allocation. After the adult family members have provided their labor as specified by the household head, they can work the small area of private plot for themselves allocated each year to them by the household head. Women devote substantial efforts to these private plots but they are very small and often poor land far from the village. Women also have difficulty getting access to purchased inputs or to organic fertilizers, which are especially critical in the poor sandy soils on which millet is grown.

The Production-Marketing Project concentrated on the principal areas controlled by the household head but set aside 10 ha for women for each 50 ha for the men. The specification is that the area of the women has to be from the private plots over which they control the output. Women cannot claim larger areas over which they lose control of the output as happened in the initial years of this project. Normally, the men have one ha, but each woman can have 0.25 ha so 40 women on the 10 ha allocated is common.

There are still various problems for the women. They usually are given the poorer land quality further from the village and have difficulty getting either the manure or organic fertilizer and the transportation for it. Since the women use more labor intensive practices and follow better the agronomic recommendations[6] than the men, it is very satisfying when the womens' plots out yield the men's and we encourage the competition. Their repayment rates on the input credits are also higher than those of the men. In several villages in 2011 in the Mopti region we held the men at a constant area but increased the area for women due to the better performance of the women in repayment. We have also begun pressing in the villages for the women to have better land quality for their private plots and to have access to animals for seed-bed preparation. We also urge the men to make the compost and the carts (to transport manure to the field) available to the women.

III.Food Processors- Nearly all (95%) of the entrepreneur food processors we work with are women (in Mopti-Gao all are, and in Bamako most are). In this year, training in sanitation and quality of processed products was provided for our women entrepreneur partners in Mopti-Gao.

IV.Training- Initially two of the five identified long term trainees were female, but one dropped out due to family issues and the USAID decision to not allow young children to accompany the trainees. However, one female trainee remained in the program and was the first to obtain the needed English skills (TOEFL score), the first to be accepted into a graduate program, and is now being considered for PhD rather than a Master's. This is both a gender achievement and a success story.

V.Preference for décrue sorghum varieties- Women are involved in a participatory selection for grain quality and ease of threshing.

VI. Décrue sorghum on-farm technology evaluation demonstrations- Of the farmers involved in the demonstration plots 41 % were women.

8. Synergic Activities

Production-Marketing

The entire program is synergistic. The Production-Marketing program started and is firmly rooted on defining the technologies with the national agricultural research organization (IER) and identifying the priority production regions with the national agricultural extension agency (DRA)

[6] The women are much more likely to do thinning and weeding on time than the men.

We collaborate with IER in getting their improved technologies into the field. Some of these technologies had been developed earlier with INTSORMIL collaboration. Then we rely on the DRA (national extension service) and several NGOs (Sasakawa and AMEDD) for the monitoring, input delivery, crop cuts and repeated interactions with the farmers' associations. We also develop ties with the private sector cereal buyers especially the millet food processors in the urban area and the emerging sector of intensive chicken producers (broilers and eggs with a focus on the former).

Our most important synergistic activity is with IICEM. USAID-Mali asked IICEM to scale up our technology project. IICEM has been concentrating on the financial aspects and farmers' associations have obtained substantial loans for millet and sorghum producers in various regions of the country principally from BNDA due to the IICEM intervention and loan guarantees. Besides technical support to IICEM we provided them with Toroniou certified seed in 2011 and will provide Grinkan seed to them in 2012.

We are also handling a series of issues on the technical pilot project side that will remain important to the scaling up of IICEM. These include the control of mildew in millet production with the appropriate fungicide, the future depletion of soil K with the continued fertilization with DAP, obtaining a price premium for the farmers' associations for the cleaner cereals, developing site specific fertilizer recommendations with increasing focus on soils laboratories and soil testing, developing the farmers' associations into functioning marketing coops, tying IER better into our farm level activities[7], improving repayment rates and farmer participation in the farmers' associations. Most of these things IICEM could not do at the same time that they are pushing for financing and a more rapid project expansion. However, a pilot project can do these activities and provide the results for the scaling up partner, IICEM.

Food Processing

For the food processing component the arranging for grain supplies from the production-marketing component of the project is an example of effective and productive synergy. We also hold joint workshops of processors and Production-Marketing farmers' associations to help build these commercial networks. In the project period, two meetings were held with IICEM at their office and B. Hamaker and M. Diouf visited with IICEM Moulin du Sahel to discuss future collaboration to facilitate larger industrial processing of sorghum and millet in Mali. Discussions are in progress regarding joint activities for assistance in industrial processing in the coming months.

INTSORMIL conducted a workshop to introduce and demonstrate new technologies for processing millet - and sorghum based products (agglomerated products). The workshop was held at the new incubation center set up by INTSORMIL and IER at the Laboratory of Food Technology of the Institute for Rural Economy from June 21 to 23. The objective of the workshop was to introduce millet and sorghum processors and INTSORMIL's partners to new processing technologies to strengthen their ability to process market competitive sorghum and millet foods and to increase the quality and value of their product. The opening ceremony was done successively by the Director of CRRA Sotuba and the National Coordinator of INTSORMIL/ Mali on behalf of the US Coordinator who was stranded in Paris because of mechanical problems of the plane. Seven beneficiaries of INTSORMIL from Gao, Mopti and Bandiagara, 2 beneficiaries of INTSORMIL from AMTCL/ Bamako, 4 partners from IICEM millet and sorghum processors participated in the workshop. INTSORMIL as well as IICEM provide support to their partners and also to other participants.

Beyond this workshop, a small meeting was scheduled on 24th June only for INTSORMIL processing team and the seven
beneficiaries from Gao, Mopti and Bandiagara. The objective of this meeting was to finalize and to sign the contract of retrocession (payback contract) on hand and to discuss and schedule for the supply of grains. Five contracts were signed.

[7] Demonstrations, the usual extension technique do not work well in the Sahelian countries. Farmers do not believe that they have the same access to inputs and techniques. With our village level technique best farmers follow the practices and then other farmers follow the next year.

Synergic Activities	U.S. Partners	Non-U.S. Partners	Details
Technology development and transfer in the décrue area	**USAID-MALI for financial support** **INTSORMIL for scientific support in technology development for millet and sorghum.** **AGRA for financial support in hybrids development** **ICRISAT for regional approach in sorghum research within West Africa**	**-Regional direction of Agriculture for technology test and expansion: (Tombouctu, Gao, Mopti Kayes)** **- NGOs for technology test and expansion in Tombouctu and Gao regions**	
		Noragric for technology development, financial support in technology development focused on main décrue crops by year 2011	**Involvement of Noragric in financial support will give more opportunity to invest USAID money in providing more equipment to monitor water dynamics in the soil profile.**
To identify performing cultivars for sustainable production of sorghum in the décrue system using participative approach		**IER sorghum breeder and pathologist DRA Tombouctou, Gao and Mopti NGO CONFIGES NGO AFRICARE NGO RCGOP**	
To determine soil nutrients deficiencies in the décrue system		**DRA Tombouctou, and Mopti**	
To diffuse integrated packages		**DRA and NGO**	

9. Other important activities

1. INTSORMIL Mali ICT Needs Assessment (see annex for complete report)

INTSORMIL MALI ICT NEEDS ASSESSMENT

by

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Introduction

The International Sorghum and Millet (INTSORMIL) Collaborative Research Support Program (CRSP) is funded by the United States Agency for International Development (USAID) with the purpose of supporting international sorghum and millet research in twenty countries including Mali in West Africa. Its goals are to improve nutrition and food security, and to increase the income of farmers who produce these two crops. It shares its research findings through a number of educational programs conducted in concert with its in-country partners. Given the nearly 100% adoption of mobile phone technology within Mali, INTSORMIL was interested in determining the potential uses for this technology to enhance its educational programming efforts.

INTSORMIL, with support from the United States Department of Agriculture's (USDA) National Institute for Food and Agriculture (NIFA) contracted with the U.S.-based eXtension to conduct a needs assessment in Mali. The assessment was conducted February 12-19, 2012. The goals of the assessment were:

- Assess needs and conditions focusing on agricultural applications in sorghum and millet production, and marketing and processing.
- Identify potential Communities of Interest (CoI) and their needs.
- Assess how research information flows to producers and in what formats and languages.
- Identify appropriate subject matter experts to participate in a future sorghum and millet Community of Practice (CoP).
- Identify potential educational and technical partners (internet, mobile, digital content, and translation).
- Assess other tech-enabled working models with an emphasis on mobile, e.g., short messaging system (SMS).
- Develop an action plan for pilot testing new Information and Communication Technology (ICT)-based strategies for use by INTSORMIL prior to September 2012.

Individuals from the following Malian agencies and organizations were interviewed as a part of the assessment:

- Association des Organisations Professionnelles Paysannes (AOPP)
- Association Malienne d'Eveil au Development (AMEDD)
- Assemblée Permanente des Chambres d'Agriculture du Mali (APCAM)
- Direction Nationale de l'Agriculture (DNA)
- Institute d'Economie Rurale (IER)
- Orange Mali
- Sasaka Africa Association
- The Cooperative for Cotton and Cereal Production in Kaniko (Sakasso region)
- United States Agency for International Development (USAID)
- Yereta-Ton farmers cooperative in Tingoni (Segou region)

Recommendations

Community of Interest

The target CoI should be members of the farmer organizations active in the 143 villages targeted by the USAID Feed the Future Initiative. Pilot efforts should be targeted at villages speaking Bambara. The initial recommended strategy should be the delivery of educational materials in audio formats to mitigate the issues of low literacy rates and SMS texting costs. As a pilot effort materials should be produced in Bambara and then scaled to include additional native languages.

Communities of Practice

The initial CoP should be focused on people in the organizations already working in the targeted villages; NGO personnel, DNA staff, and IER scientists. A team needs to be identified and tasked with organizing the CoP effort as their primary responsibility. The initial efforts of the CoP need to be focused on the development of educational materials in native languages. Currently, even if appropriate ICTs were to be identified for reaching the farmers in the villages there is no learner-appropriate content to be delivered. The first and highest priority needs to be the development of a system for the collaborative creation of educational materials. At the national level, organizing the sorghum and millet CoP needs to be coordinated through AOPP, APCAM, DNA, IER, and the various NGOs.

An organizing effort needs to be started, governance determined, and intellectual property rights agreed upon. A neutral and open copyright like that offered through Creative Commons should be agreed upon from the start. A potential partner is OER Africa through their AgShare project.

Information and Communication Technologies

ICTs without appropriate educational content for delivery are of little value. The first priority needs to be developing the capacity to produce audio-based educational materials.

Phase 1: The first and highest priority is to create the capacity to produce audio educational materials in native languages. These capabilities need to be either created or acquired through partnership. A potential partner for assistance is Mali national radio (Office de Radiodiffusion Télévision Malienne).

Phase 2: Create a system for the distribution of dynamic and timely information to radio stations. Establish a budget for the regular airing of audio materials in various formats: announcements, interviews, panel discussions, etc. Mailing list

capabilities for reaching the various demographics will need to be established. A potential partner for this effort is Farm Radio International which has nine representatives working in Mali.

A neutral Web-based collaborative work system needs to be established to support the creation of a CoP. This system could also be used for the archival and distribution of audio recordings, scripts (in both French and native languages), as well as other educational materials. Where this system won't serve the CoI directly, it will serve their needs indirectly through strengthening the efforts of the CoP. To scale this to an appropriate level will require dedicated administrative, educational, and technical support.

Phase 3: Explore distributing the audio and other graphic-based educational materials directly to the villages using non-networked technologies such as e-readers. A potential partner for e-reader technology is Worldreader (USAID is already a partner).

Phase 4: Establish a system for the distribution of shorter audio messages via a bulk phone voice broadcasting systems, or potentially SMS to speech technologies.

2. YouTube Movies

INTSORMIL's Channel: http://www.youtube.com/user/INTSORMIL

INTSORMIL Produced Movies:

Decrue Sorghum in Mali Africa
http://www.youtube.com/watch?v=JsJAegMl9vw&feature=plcp

Decrue Story
http://www.youtube.com/watch?v=y6aY4JqLMA0&feature=plcp

IER: Collaboration Produces Improved Sorghum
http://www.youtube.com/watch?v=OnGEFNiY-SE&feature=plcp

IER / INTSORMIL: Collaboration
http://www.youtube.com/watch?v=WxDZlMsXgJE&feature=plcp

IER: Institutional and Human Capacity Building at IER
http://www.youtube.com/watch?v=kTXDGVPYNyU&feature=plcp

IER: Production and Marketing Project in Mali
http://www.youtube.com/watch?v=fgbE43Zomh0&feature=plcp

IER: Breeding Food Grain Quality Sorghum and Pearl Millet

http://www.youtube.com/watch?v=zPDeLkdXTBA&feature=plcp

IER: Delican: a sorghum based biscuit made in Mali
http://www.youtube.com/watch?v=dDTi3nRzEdk&feature=plcp

IER: Transforming Sorghum and Millet Grain into Flour in Mali
http://www.youtube.com/watch?v=BuZqdWYnjXY&feature=plcp

IER: Scientists in the Battle Against Hunger
http://www.youtube.com/watch?v=JY6n9lUHtQY&feature=plcp

IER and INTSORMIL: Partners in the Battle for Food Security in Mali
http://www.youtube.com/watch?v=WrfyXxnAX5o&feature=plcp

IER and INTSORMIL: Human Capacity Building at IER
http://www.youtube.com/watch?v=1ACPOxVKZGE&feature=plcp

IER Improved Sorghum and Pearl Millet Varieties: Weapons in the battle Against Hunger in Mali
http://www.youtube.com/watch?v=CzI6oUZiKdU&list=UU5ViF16XJgywqKun2gXsm2w&index=3&feature=plpp_video

IER, AMEDD and INTSORMIL: Partners in the Battle for Food Security in Mali
http://www.youtube.com/watch?v=g2054iawDkk&list=UU5ViF16XJgywqKun2gXsm2w&index=2&feature=plpp_video

IER and INTSORMIL: Promoting the Production and Marketing of Sorghum and Pearl Millet in Mali
http://www.youtube.com/watch?v=pSkzDn8BKj4&list=UU5ViF16XJgywqKun2gXsm2w&index=1&feature=plpp_video

In Production Mali Movies:

IER and INTSORMIL: Developing Malian Food Processing Entrepreneurs

10. Problems, Challenges and Solutions

1. Sorghum and pearl millet yields in Mali

- **Yield constraints to sorghum and millet production in Mali**

The principal constraint to high yields is soil fertility. Hence our technology strategy is moderate inorganic fertilizer with water retention technologies to reduce the riskiness of fertilization and new cultivars to give higher yields without lodging. Note that water availability is also critical. There was too much rain in many regions in 2010 so sorghum which is planted primarily on the lowlands was adversely affected but millet grown on principally on the plateau and slopes had great yields. This year there has been a late lack of rain and in many regions another good rain is necessary for grain filling according to Ouendeba. In these years sorghum on the lowlands will do better and millet can be most adversely affected. Farmers are aware of these differences, have different methods of reducing risk and we also have a series of measures to handle risk built into the program.

The estimates of yields are preliminary from an experienced agronomist as it was still not harvest season when we made these estimates. From the field visits Botorou Ouendeba estimated that sorghum yields in our seed production plots would be approximately 2 t/ha. These are very good yields. Seed producers get a quality premium price so usually are careful to do the agronomy recommendations. Normally we are very happy with millet yields of 1.2 to 1.4 t/ha as millet is grown on poorer soils with lower soil fertility and often more water stress than sorghum. We observed very good millet fields in Segou and in Mopti and Ouendeba felt that if there was a little more rain in the grain filling stage there would be yields of 1.7 to 2 tons. This indicates good seed quality and excellent observance of the agronomic recommendations as well as using organic fertilizers.

- **Yields of farmers that do not follow the recommendations**

Farmers not in the program and not following recommendations in the Koutiala region but following the cotton rotation and therefore getting the residual effects of cotton fertilization (P) get 800 kg to a ton/ha of sorghum. Millet producers in the Segou region get 500 to 600 kg/ha and 400 to 500 kg/ha in the Mopti region.

- **Barriers to technology adoption: What are farmers doing instead?**

Why is there still substantial yield variation even though we are increasing substantially mean yields? Farmers need to follow the recommendations. With only moderate fertilization you have to make sure that the plants have access to it hence the importance of side dressing. There is resistance to side dressing of fertilizer and thinning because they are new practices and more labor intensive. Instead of side dressing, farmers often broadcast and often have their kids do the fertilization. Sometimes they do not cover the fertilizer and it volatizes. Also, plant thinning is important but it is hard and farmers often have the erroneous idea that more plants and taller off types are better. We have run regressions on yields and both deviations (fertilizer and plant thinning) from recommendations have large yield costs. So we keep visiting them and going over the basic agronomical, marketing and organizational recommendations for the program

For this reason we introduce the technology to groups of farmers in the village. Sahelian farmers (that we know) do not believe in demonstration trials. They feel generally that this is something that is difficult for them to get all the inputs and practices together to do. But they do follow what other farmers are successful with. If 50 farmers adopt the technology in a village (and we try to get this number in each village where we start operating the program), 15 to 20 will follow well the recommendations in Year 1. In the second year, most of the farmers in the village will follow the recommendations.

2. Seed production

The main problem of the 2011 crop year was renewing the supply of high quality seed for our excellent cultivar, Grinkan. In the Koutiala cercle and in IER experiment stations we now have 12 ha in seed production of Grinkan from which we will obtain 12 to 18 tons of seed. Also good seed of the two progeny of Grinkan will be obtained from the sites of Kita and Beleco. So we will have sufficient seed for a substantial area expansion in Koutiala. We will need 8 tons of seed 1000 ha there in 2012.We will also be able to supply IICEM with substantial quantity of Grinkan and progeny seed.

3. Downy Mildew: impact on grain yield and its management

Downy mildew (*Sclerospora graminicola*) was observed to be a minor constraint in the Mopti Region this year. We estimate that yield losses were <5%. Downy mildew is the major disease of millet in West Africa and may affect all of the above-ground parts of the plant including the panicle and leaves (see symptoms in photos below). It is a seed transmitted disease and can have a devastating effect on grain yield. Yield losses due to this disease have been reported to range from 3.5 to 21% in Mali according to John Leslie (Sorghum and Millet Diseases, 2002).

Substantial work has been done in international centers looking for resistance and there have been good resistant varieties developed for India by David Andrews (formerly with INTSORMIL after his time in ICRISAT) and

widely disseminated. The millet varieties introduced earlier in the region (ICRISAT-Sadore in Niger) were completely wiped out. We are using an integrated approach (tolerant improved cultivar + seed treatment) to prevent the losses. The improved local cultivar (Toroniou) used in Segou and Mopti regions is tolerant to mildew but we recommend also the use of Apron Star (fungicide-insecticide) to treat the seed before planting. In Mopti region, the extension agent purchased in 2011 a cheap fungicide and the mildew infestation on the secondary tillers was around 5% (tolerant reaction).

We have explained to farmers the seed transmission characteristic of downy mildew and the need to use the appropriate fungicide for the next crop. Here it should be pointed out that the failure of the extension service and the farmers to follow recommendations is a continual problem of education. Note our "fiche technique" explaining these for both sorghum and millet. We give these out to farmers (farmers like the pictures) in our on- farm training programs and we discuss the agronomic and marketing aspects with the farmers.

4. Dirty grain: the need for clean grain for use by food processors

Farmers are getting better at using the bache and also screens (Segou). But there are still problems. Beating the grain with "batons" on the "bache" or running over it with tractors destroys the "bache." The appropriate long term solution is mechanical threshers. But the small machines tend to break down easily especially under the joint ownership of the farmers' associations. We need bigger machines doing custom work as in Senegal. How to finance and organize this for the various zones of production now that the area in the new technologies is expanding rapidly is a question we need to address in 2012.

5. Repairs on mechanical threshers

In Tingoni, Sasakawa (our collaborator in the Segou region) introduced mechanical threshers during the last four years, three of which we collaborated closely with them. Our observations over these three years is that the threshers are not dependable due to frequent breakdowns. The problem with the breakdown of the threshers was the lack of ownership of the machine and thus poor maintenance and poor threshing methods . People in the village just used it until it broke down. The millet from the Segou region is known to have the highest impurity level (sand, stones and physical impurities). The millet heads are spread on the ground and a tractor is used to run on the pile to do the threshing. When millet is threshed on the ground, dirt, pebbles and other debris end up in the machine and it breaks down. However in the Mopti region the millet grain is clean because the threshing is done in large mortars by women. But when dealing with large quantities, the threshing becomes very painful. The woman cannot thresh more than 100 kg of grain all day long. Thus threshers are needed.

The solution to the threshing problem? Individual (private) owners that can make a profit by providing commercial threshing services. Private owners need to be able to make simple repairs and make sure that the millet is not dirty. This would be a better ownership method than Sasakawa's procedure of just simply making the equipment available to the village without proper management. In Senegal for example, there are larger and more dependable machines that individuals travel around with and do commercial threshing services. Breakdowns there are not a major problem. In Kaolack region, the largest millet growing zone in Senegal, we met a private person who uses a big thresher (1 ton of grain per hour) to do services after harvest in the different villages, from December to February of each year.

Therefore millet threshers exist and work. Farmers in the greater region of Segou or Mopti could use the same strategy. With established ownership rights in Mali the owner would charge for services, check for the quality of the cereal being introduced into the thresher and would know how to do repairs. They might also be able to do this with the smaller machines made locally in Mali.

6. Mechanical issues with the mechanized food processing units

Mechanical issues are always a potential problem with mechanized processing units and we do have problems in this area, though they are manageable and can be dealt with. We are striving to make successful examples with the Sotuba Incubation Center and are already working with two Bamako area entrepreneurs in this regard. Our goal is to have this be a model for processing technology transfer and for it to be sustaining after the finish of the project through other partners, training fees, and entrepreneur fees.

7. What is the progress in increasing grain yields over time?

Each year in the spring or summer after the previous crop year (at this time because we need to wait for the farmers and associations to sell later after the price recovery) we interview farmers and get yields, prices received, incomes as well as estimates of yields of the farmers not in the program and prices received by these farmers. The progress in increasing grain yields is given' in our reports and they also show the profitability to farmers of these activities. Each year rainfall and other conditions are different so the best way to analyze this data is to take into account the climatic and other factors and to compare yields, prices and incomes with those not participating in the program. The between year comparsions suffer from the differences in climatic and other stochastic and economic factors. Yield comparisons over time do not mean much if one year was flooded (very adverse effect on sorghum and very good effect on millet- as in 2010) and another year was very dry at a critical period. But the best way to evaluate profitability and sustainability is to talk to our farmers associations.

8. Drought damage in décrue sorghum

After the river or lake water recedes drought is a common problem in the décrue culture in Kayes Region. Solutions are:

1. The planting of drought tolerant genotypes such as Saba Soto and Saba Tienda which have extensive root systems as based on our studies and yield well in Mali under drought conditions.
2. Planting against the slope to prevent soil erosion and thus conserve moisture.
3. Use of tied ridges as has been shown by Sander's project to be effective in preventing rain run-off. The ridges will be constructed before planting and after the lake or river water recedes and will be used to catch the limited rainfall which occurs prior to the dry season.

9. Selection of academic trainees

Our initial proposal strongly suggested that selected participants acquire the needed English language skills in Mali, and then the training program would include a 6-month intensive English language component to bring them to the needed English skill level (TOEFL requirement) for graduate school admission. The five identified candidates were not already proficient in English and the time and resources were not available for English training in Mali. So our challenge has been to adjust our program plan, budget and timeline to first get all participants to the required English skill level to succeed in Master's programs; and second to identify Master's programs that would fulfill their training needs. To date we have accomplished English skill development and admission to graduate programs for all five participants.

Solution:

1. In selecting trainees a more rigid screening process should be conducted and only those with adequate English skills should be accepted.
2. Selected trainees should take English classes in Bamako where it is much cheaper than in the U.S.
3. Only applicants who successfully pass the English training in Bamako should be nominated to U.S. universities.

10. Fulfilling gender requirements in long term training

The USAID Mali Mission requested that 50% of the academic trainees be women. However only 20% (one woman) was selected due to pregnancies and a recent birth. Since the USAID Mission/Mali did not approve one candidate to bring her new born child we had to replace her with a male since no other women candidates were available.

11. Security problem in northern Mali

The travel ban for U.S. PIs to the Tombouctou area makes it difficult to manage the Décrue Sorghum project.

12. Goat and poultry industry

There is a great potential for the use of sorghum and millet grain for the use as feed for poultry and grain and stover (forage) for the goat industry in Kayes region. Breeders should identify suitable genotypes for these purposes. Some of the highly digestible *bmr* (brown midrib varieties) developed by the CENTA program in El Salvador and now being evaluated in Central America and Haiti should be evaluated in Mali. These varieties are expected to increase milk production by 20%.

13. Seed production system

The lack of an effective and efficient seed production system has hampered our projects. Poor germination and varietal mixtures are often a constraint greatly limiting yields in our demonstration plots. In order to implement a wide diffusion of Saba Tienda and Saba Sôtô for the décrue system, seed production of the former and seed purification of the latter are needed. These are constraints that have to be resolved by IER and the national program.

14. Bank involvement

A constant constraint for the Production-Marketing Pilot Project was to develop a strategy to increase local bank involvement in input finance at the start of the crop season so that input financing now provided by INTSORMIL can be transferred to local banks for sustainability of the project.

15. Pest problems in storage facilities

To minimize insect damage to grain in storage it is necessary to substantially increase the use of PICs sacks and improve the management of grains in storage.

16. Feed production

The use of sorghum grain in the Kayes décrue system could be one way to link sorghum grain production to poultry production and the use of improved sorghum stover used for goat feeding. Sorghum breeders need to be encouraged to develop new genotypes suitable for the use of grain for human food, poultry feeding and the use of stover for goat milk production for the Kayes Region.

17. Seed quality

For millet our most important problem is clean seed. The canvas ("bache") we obtain for the farmers' associations to put on the ground are often torn up especially by running machinery over them to thresh. It is necessary to identify good threshing machines and work out a system to help the farmers' association either purchase them from their profits or obtain bank loans to purchase them. Management and maintenance of these machines is also very important. This should probably be done privately rather than as a group function.

18. Markets for sorghum

For sorghum the most important problem is new markets. We have identified the priority of selling to the intensive chicken producers. Now it is necessary to identify which firms have the requisite mixers to do that and when the relative prices (maize-sorghum) are favorable provide the information or incentives for this substitution.

19. Farmer training

We have published production guides (Package of Practices) for sorghum and millet which provide cookbooks for the necessary components of the program. However, these are for governmental agencies and the trainers. Who will do the training and what additional supporting materials do they need? The agronomy is simpler as the instructions are laid out in detail in our "fiche technique." However, the business management concepts to develop the farmers' association leadership and their members' ability to control them to work for the common good still need to be identified and incorporated into the fiche technique.

20. Scaling up

It is going to be very hard to continue the scaling up the Production-Marketing project by the contracting of consulting agencies as they are not sufficiently familiar with the technical and economic problems that can occur. The seed problem was serious in 2011 and there will be other biological and economic problems. The most important concept is to simultaneously improve extension of the complete package (moderate fertilization, an improved cultivar, good seed, a water retention technique and improved agronomy) and to improve the marketing through a farmers' association. This is a lot of pieces to put together but it appears that they are all necessary.

21. USAID lack of continuity

The agency has little continuity as each new generation of technical leaders wants to start something new that they are associated with rather than continuing successful programs and thus achieving greater impact from continuity over time. Forcing us to change project sites in the middle of our contract significantly decreased our targeted impact.

11. Success Stories (see Annexes)

- ***Malian Thick Sorghum and Millet Porridges Decrease Hunger***
- ***Rooting Depth and Architecture are Critical for Productivity of Décrue Sorghum***

12. Lessons learned, Achievements and Recommendations

Training

- To help reduce the time and cost for English training in the US, and to better assure graduate program success, it would be best for future academic candidates to have English language training in-country before traveling to the U.S. The original proposal stated this requirement, but the criterion was not upheld.
- It is and will be difficult to recruit African female researchers for long term training with USAID's strict policy not to allow family or dependents to accompany the student.
- Developing personal connections between students and faculty/program administrators proved to be very important. Due to the Coup d'Etat- caused ban on funding the GOM four of the five students would not have been allowed to finish their program if faculty had not found non-governmental funding to support the final portions of their research.

Technology Transfer Activities

1. Now both the government of Mali and Feed the Future in Mali put a priority on the development of the sorghum and millet activities in the country;

2. IICEM has been commissioned by AID-Mali to scale up on a national level the technology recommendations and cultivars that this project has identified and field tested;
3. We have designed a supplemental strategy for incorporating improved marketing practices and the development of farmers' associations into the technology diffusion activities of IICEM and other technology introducing agencies including the national extension service and DRA;
4. Simple guidelines for sorghum and millet production in French, Bambara and Dogon have been published and published in "fiche technique" giving agronomic, marketing and institutional development instructions for a wider diffusion of the project model;
5. IER and DRA should take the lead in using these packages of practices to transfer the recommendations to farmers via technology transfer agents;
6. These packages of practices provide "content" which should be packaged and transmitted to farmers via ICT media e.g. radio and E-Readers as recommended in the *ICT Needs Assessment* summary herein.
7. In Koutiala and Mopti there is widespread introduction of the new technologies, new storage facilities, and farmers' associations;
8. The incubator model for food processing was developed. Processing equipment and training for using this equipment has been introduced into the USAID priority regions in the north and an incubation unit for processors has been introduced in Sotuba with IER for national use including the Feed the Future priority regions;
9. From agronomic experimentation new cultivars and fertilizer recommendations have been made for the décrue sorghum. Farmer organizations will be formed in 2012 in Mopti, Timbuktu, Gao and Kayes and technology transfer activities will take place through these organizations. INTSORMIL/IER Décrue Project researchers have thus gotten further towards release and introduction of new technologies than the French researchers who have previously invested substantially in this research;
10. Within IER and DRA we have demonstrated the importance of a service attitude towards farmers, transparency, and the need to take responsibility for final results of funded projects.
11. As we exit and turn over activities to IER and DRA we stress that it will continue to be important to:

a) Focus on good seed production of millet and sorghum;
b) Help IER move away from a focus on research to put more effort on service to their farmer clientele. This service attitude will ultimately enable IER to obtain increased research funds from their own government;
c) Facilitate DRA in professionalizing their technicians and evaluating them by the performance of their farmer clients;
d) Collaborate with IICEM in adding marketing services to their scaling up. Presently, IICEM focuses on facilitating bank lending to farmers' associations but leaves the marketing to the big oligopolistic firms, which have a propensity for taking all of the marketing margin for themselves;
e) Collaborate with IICEM in maintaining high levels of new technology and farmer training in agronomy as basic components of their scaling up process;
f) Extend this service concept being implemented with IER and DRA into soil testing services and expand the quality and number of soil testing labs servicing farmers.
g) Help IER and DRA better focus their functions around the most pressing needs of farmers and furnish a regular supply of new technologies to the farmers' associations involved in this process;
h) Understand and facilitate the shift to greater emphasis on those crops that have the greatest potential for rapid domestic expansion, especially the cereals but also poultry, milk, fruits and vegetables. This focus on domestic markets will translate to greater positive economic effects on domestic consumers and small farmers as compared to the promotion of export activities.
i) Encourage IER to develop soil fertility recommendations. In the last two decades when Mali needed to be investing in soil labs, doing soil testing and producing soil specific recommendations for farmers, the low

fertilizer input philosophy dominated. Now we still need soil and region specific recommendations for our farm level work. For example, the response of decrue sorghum to fertilizer depended upon the soil type and location. In poor soils such as those in Tonka, the sorghum crop responds to nutrients. Maximum decreases in grain yield were observed when N or P were deficient. In some locations no response was observed. Thus, a future IER activity needs to include the modernization and acceleration of the soil testing activity in Mali. Testing and recommendations need to be provided at a low price to farmers. Publishing of the soil testing results should be done so that the empirical basis for soil specific soil fertility recommendations at a farm level can be developed.

j) IER must be proactive in developing the poultry market for millet and sorghum grain. IER must target mixers and intensive producers with the requisite equipment for mixing when the prices are favorable for sorghum relative to maize and push more proactively to overcome the inertia in staying with a maize based ration.

13. Annexes

A. Package of Practices for Sorghum and Millet

FICHE DE PRODUCTION ET DE COMMERCIALISATION DU SORGHO, MALI

MARS 2011

FRENCH VERSION

FICHE DE PRODUCTION ET DE COMMERCIALISATION DU SORGHO, MALI

MARS 2011

Variété GRINKAN à maturité, Garasso, Mali, 2010

Pour plus de détails et d'information sur les futures modules de formation, prière contacter Botorou Ouendeba, Projet Production et Marketing (INTSORMIL): bouendeba@yahoo.com

Production

Le programme IER/INTSORMIL/IICEM comporte plusieurs volets.

- Amélioration des technologies de production; Recommandations agronomiques
- Introduction de stratégies de commercialisation : Comment les producteurs peuvent obtenir des prix élevés a travers la mise en œuvre de stratégies
- Développement institutionnel des associations de producteurs

I. Agronomie

1. Zone de production et choix du champ paysan

- Zone de production : pluviométrie
- Choix du terrain : Le champ choisi **ne doit pas être un champ pauvre ou marginal**, mais doit être plat et homogène. Le sol du champ doit être de type sableux-limoneux ou limoneux-argileux ou tout type de sol adapté à la bonne production du sorgho dans la localité.

2. Préparation du sol

Le semis se fait sur des anciens ou nouveaux billons après une pluie de 20 mm. Un ressemis est prévus en cas de mauvaise levée après une dizaine de jours.

3. **Quantité de semence à l'hectare** est de 8-10 kg/ha.

4. Traitement de semences.

Cette semence doit être traitée avec un fongicide insecticide (un sachet d'Apron star pour 10kg de semence) ou suivant l'indication du fabriquant.

5. Doses et Application d'engrais

- **Apport de 50 kg/ha de DAP :**
  Le DAP est apporté à la levée au pied du poquet ; cet apport doit être suivi d'un sarclo-binage pour couvrir l'engrais.
- **Apport de 50 kg/ha d'Urée** : L'urée est apportée autour du poquet 45 jours après la levée ; cet engrais est **enfoui** dès son épandage.

6. Date et densité de semis

- **Période de semis** : La période de semis est spécifique à la zone de production
- **Densité de semis**

Pour le sorgho, l'écartement de semis entre les billons est de **0.75m** et il est de 0.50 m entre les poquets sur le billon (soit **0.75m x 0.50m)**.

7. Démariage

Sorgho : le démariage se fait deux à trois semaines au plus tard après la levée. Le nombre de plants par ha est estimé à **53 600** pour un démariage à 2 plants par poquet et de **80400** plants pour un démariage à 3 plants par poquet.

8. Entretiens culturaux

Pour éliminer les compétitions (pour les éléments nutritifs et aussi pour la lumière) avec les mauvaises herbes; le sarclage doit se faire à la demande pour maintenir le champ propre.

9. Protection des cultures

Au cours de la croissance végétative les cultures sont souvent soumises à des pressions parasitaires : maladies foliaires, attaques de punaises de panicules, de moisissure et bien d'autres fléaux. Les services de vulgarisation de la région doivent être informés afin de connaitre les dispositions à prendre.

10. Carrés de rendement et estimation des rendements

Cinq carrés de rendement de 5m x 5m chacun est placé dans un hectare d'un producteur. Il y'aura un carré à chaque coin de l'hectare et un autre au milieu du même hectare. Il est demandé de prendre au hasard 10 producteurs par zone pour un total de 50 carrés de rendement par zone. Le nombre de panicules, le poids des panicules et le poids de grain après battage pour chaque carré de rendement doivent être reportés dans le cahier des observations de l'agent chargé du suivi**.**

11. Récolte

La récolte se fait quand les grains sont complètement mûrs.

Recommandation: pour éviter tout contact avec le sable, les panicules récoltées ne doivent pas être séchées sur le sol mais sur des tiges ou d'autres matériaux disponibles tels que des petits hangars confectionnés pour les circonstances.

12. Battage

Pour le battage, les producteurs peuvent utiliser une batteuse mil, des bâtons ou des mortiers avec pilons sur des aires bien propres. Utiliser dans tous les cas des bâches pour éviter que les grains ne touchent le sol ou d'autres impuretés.

Il faut toujours garder à l'esprit que l'objectif du programme est d'avoir un produit final (grains) très propre et de bonne qualité qui doit conduire à l'obtention d'un premium pour les paysans.

II. Techniques Post-Récolte

1. Magasin

Respecter le dispositif recommandé pour le stockage des sacs; utiliser des palettes pour éviter que les sacs soient à même sur le ciment; laisser des allées entre les piles de sacs afin de maintenir la propreté du local et si nécessaire faire des traitements contre les insectes.

2. Ensachage

Les sacs plastiques normaux ont montré leur limite concernant les attaques d'insectes de stockage. La solution serait d'utiliser des sacs PICS connus pour stocker des grains de niébé et certainement des grains de céréales pour une longue durée (plus de 6 mois).

3. Contrôle de la qualité des grains

Tous les sacs amenés par les producteurs vont porter les noms de ces producteurs pour s'assurer de la traçabilité des grains. Un échantillonnage est fait au niveau des sacs stockés dans le magasin (10% du stock total). Ces échantillons (3 échantillons par sac) seront analysés pour déterminer l'humidité et les taux d'impuretés (sable, cailloux, débris végétaux et autres matières inertes). Ces informations sont mises à la disposition des acheteurs.

III.Stratégies de commercialisation

Pour éviter les deux principales chutes de prix et avoir des prix élevés (ou de bas prix d'intrants à l'achat) pour les paysans.

1. Eviter la chute de prix à **la récolte**

L'association des producteurs aide les paysans à vendre plus tard après les bas prix observés à la récolte

2. Vendre des céréales propres et exiger un sur- prix

Les producteurs individuels utilisent des techniques (bâches, batteuse, garder les céréales au-dessus du sol).pour produire des céréales propres. Les paysans sèment aussi une variété uniforme. L'association des producteurs exige un prix premium (20 fcfa) pour la céréale propre.

3. Devenir commerçant et vendre sur le marché à un meilleur prix

De nouveaux marchés se développent et l'association des producteurs devient une commerçante avec des facilités de stockage et donc de larges quantités que l'association des producteurs peut vendre aux transformateurs (alimentation humaine) ou aux producteurs d'aliments de bétail ou de volaille pour la production intensive de poulets (sorgho). En éliminant les intermédiaires, on pourrait obtenir des pris très élevés.

4. Renforcer les capacités de l'association de producteurs à vendre des céréales à un bon prix et à acheter des intrants pour ses membres

L'association des producteurs stocke et vend plus tard (avril - mai) des quantités beaucoup plus importantes qu'un producteur individuel. Elle cherche des acheteurs et obtient un prix premium avec plus d'information et un stockage plus long. Les producteurs peuvent aussi faire un achat groupé et obtenir une réduction des prix des intrants.

IV. **Renforcement des associations de producteurs**

Les producteurs ont besoin d'un pouvoir de négociation avec des produits compétitifs pour avoir des prix élevés dans la commercialisation (et aussi pour obtenir à l'achat des coûts d'intrants réduits). En développant des coopératives de commercialisation, les producteurs vont acquérir cette capacité de négociation.

1. Développent des associations de producteurs

Dans chaque village une association de producteurs est initiée ou bien le groupement existant est renforcé

2. Construire un magasin

Des magasins de stockage sont nécessaires ; s'il n'y en a pas nous recherchons de bailleurs de fonds intéressés à faire l'investissement pour leur construction

3. L'association est responsable de la production de céréales propres et du remboursement de crédit de ses membres

Les gestionnaires de l'association doivent être responsables du remboursement des crédits pris pour l'achat des intrants pour ses membres

4. L'association obtient du crédit pour ses membres

L'association développe des relations avec une banque de la région ou des institutions financières par l'ouverture de compte au nom de l'association. Cette relation va favoriser l'octroi de prêts pour faire du warrantage ou d'autres activités génératrices de revenus pour l'association. Une organisation de producteurs forte conduit à des prix élevés et facilite aussi l'accès aux crédits bancaires donc aux engrais

V. Production de semences

Au fur et à mesure que les superficies emblavées deviennent importantes avec le programme de scaling up, la production et l'approvisionnement en semences de qualite devient une problematique.

1. Production de semences au niveau des producteurs locaux

Au delà de plusieurs centaines d'ha, il faut commencer à assurer un approvisionnement régulier de semences des variétés adoptées en formant des paysans semenciers pour produire des semences certifiées en étroite collaboration avec les services de l'agriculture (Service Semencier National: SSN). Ces semences devraient être utilisées par les producteurs au plus pendant 3 ans. Au delà de 3 ans, le pourcentage de mélanges avec les autres variétés cultivées dans la zone devient important. L'arrivée prochaine en milieu paysan de cultivars hybrides va augmenter de manière significative la productivité et la production. A l'inverse de ce qui se passe avec les variétés, chez les hybrides les semences doivent être renouvelées chaque année. La formation des producteurs semenciers entreprise avec les variétés facilitera la production de semences hybrides en milieu paysan.

2. Conditions de production de semences :
Isolement des parcelles de production ; épuration des hors-types ; suivi rapproché pour contrôler l'homogénéité du cultivar.

3. Payer un bon prix pour les semences de qualité.
L'effort founi par le producteur semencier depuis les semis jusqu'à l'emballage en passant par l'élimination périodique des plants hors types, doit être récompensé. C'est pourqoi il est nécessaire que le prix de semence obtenu à la vente soit incitatif, condition essentielle pour attirer le secteur privé.

Commercialisation

Pour favoriser et assurer l'adoption du paquet technologique (fiche de production et de récolte du sorgho) et permettre la maximisation des prix pour les paysans, il y a lieu de procéder en plusieurs étapes. Cela pérennisera la stratégie sur une base d'affaires.

I. Adoption du paquet technologique

1. Le paquet technologique exige l'utilisation optimale des intrants (fertilisants et semences améliorées) et des outils post récoltes (bâche et sacs appropriés d'ensachage).
2. Les organisations de producteurs qui ne possèdent pas de fonds de roulement suffisant pour appliquer ce paquet technologique doivent chercher des prêts/crédits auprès d'une institution financière.
3. Les institutions financières exigent habituellement une garantie (financière ou physique). A défaut, les organisations paysannes doivent avoir dans leur demande de financement un contrat d'achat dument signé avec un commerçant ou une entreprise connue de la place.
4. Le contrat d'achat comporte un cahier de charge incluant des critères de qualité de la céréale : variété, humidité, taux d'impureté.
5. Le contrat d'achat comporte le prix du marché plus un premium pour la qualité. Le contrat avec le remboursement direct payera l'emprunt de l'institution financière. Ce système permet l'utilisation du paquet technologique et assurer le remboursement rapide de l'emprunt. Les excédents céréaliers qui restent peuvent alors s'inscrire dans la stratégie de maximisation de revenu.

II. Maximiser le revenu

1. Les producteurs utilisent l'ensemble des semences améliorées et des fertilisants sur les hectares faisant l'objet du paquet technologique. Ils respectent l'itinéraire technique et les conseils agronomiques (fiche de production et de récolte du sorgho).
2. Les paysans sèment une variété uniforme, selon le cahier de charge du contrat.

3. Les producteurs individuels utilisent des techniques (bâches, batteuse, conservation des céréales au-dessus du sol) pour produire des céréales propres.
4. L'organisation paysanne regroupe les céréales propres et les stockent dans un entrepôt adéquat. Les volumes stockés permettent de négocier en gros, ouvrant de nouveaux marchés.
5. Les volumes en gros de céréales propres dans un conditionnement et un entrepôt adéquat permettent d'obtenir une prime sur le prix du marché local, maximisant la marge de revenu des producteurs.
6. L'organisation paysanne développe une stratégie de vente à plusieurs acheteurs et segments de marché. Cette stratégie de diversification des ventes diminue les risques de concentration sur un seul acheteur et assure la maximation du prix de vente.
7. Les différents acheteurs et segments de marché sont principalement: les petits transformateurs (alimentation humaine), les producteurs d'aliments de bétail ou de volaille pour la production intensive de poulets de chair (sorgho), les appels d'offres des organisations internationales et du gouvernement pour combler leur besoin en sécurité alimentaire (PAM, CRS, OPAM, Commissariat à la sécurité alimentaire, etc.) et les appels d'offres des grands moulins et commerçants. Elle peut aussi vendre à son acheteur «de sécurité » si les parties s'entendent sur le prix de vente.

III. Crédibiliser l'organisation paysanne

1. Les producteurs ont besoin d'être crédibles : vendre des produits recherchés et compétitifs pour avoir des bons prix, acheter les intrants en gros pour bénéficier d'une réduction du coût et finalement, obtenir le financement nécessaire auprès des institutions financières. En développant des coopératives crédibles, les producteurs vont acquérir une force de négociation.
2. Dans chaque village, une ou plusieurs coopératives sont mises en place, avec récépissé légal.
3. Des magasins de stockage sont nécessaires afin de dégager des quantités suffisantes permettant de développer des marchés de gros.
4. Les gestionnaires de l'association doivent être responsables du remboursement des crédits qui sont utilisés plus tard pour l'achat des intrants (semences, fongicides et engrais)
5. Pour assurer la crédibilité des organisations de producteurs, il faut une bonne gouvernance, une meilleure organisation et une autonomie financière. Les organisations de producteurs devront rechercher les connaissances et les habiletés suivantes:
   - Mécanisme de gestion, par des outils simples de comptabilité et de transparence ;
   - Mécanisme de capitalisation et de génération des ressources propres, par la distinction entre part sociale de l'organisation et les capitaux des activités économiques de l'organisation;
6. La coopérative développe ses statuts et règlements, en conformité avec la Loi des Coopératives de l'OHADA. Vie coopérative, statuts et règlements, réunion statutaire, exigence de la loi en termes de gestion.

SORGHUM PRODUCTION MANUAL FOR SOUTHERN MALI

Bambara version

IICEM USAID IER INSORMIL ***KA BAARA KƐ BOLO JɔSENW KA CA.***

-ka sɔrɔ labuguya ni fɛɛrɛw kuraw ye

-ka feere kɛ cɔgɔ fɛɛrɛw jira cikɛlaw la walasa u ka songon ba sɔrɔ u ka feere finw nan.

-ka fɛɛrɛ kɛ walasa cikɛ tɔnɔ ka kɛ sara kɔnɔ.

I- sɛnɛ:

1- cikɛ da ani cikɛla ka foro sugantili

- cikɛda : san hakɛ

- yɔrɔ sugantili : foro sugantilen makan ka ke foro sɛngɛlen ye walima foro min tun bila la bolo kɔfɛ, a yɔrɔ ka kan ka ke yɔrɔ da kɛŋɛlen ye ani k'a fan bɛɛ kɛ kelen ye. Foro dugu makolo ka kan ka kɛ cincin ani bɔgɔ mugu canga minlen ŋɔnjɔn nan walima foro minnube ye ni keninke bɛse ka sɛnɛ a yɔrɔ la.

2- dugukolo labɛn cogo :

Danni bɛkɛdugu walan kɔrɔ walima kuraw kan, ni sanji nanan ka se milimɛtɛrɛ 20 man. Tilen 10 kofɛ, sengin bɛ se ka kɛ danni kan n'a sɔrɔ Danni kunfolo ma fallen kaŋɛ.

3- ŋɔsi kilo 8 ka ta se kilo 10 ma, de bɛ dan foro.

4-ŋɔsi fura kɛ cogo :

Fin ŋanaman galan de bɛ kɛ ŋɔsi na ina fɔ « apron star » ma na ni bɔrɔ kelen ko ŋanga mi ŋɔsi kilo 10 man walima a ka ke ina fo finŋanaman fagalan dilanbaga ye a fɔ cɔgɔ min.

5- nɔgɔ don cogo a na hakɛ :

-DAP kilo 50 ko dan taari kelen na.DAP bɛ don ŋɔ sun ju falelen kɔrɔ.nɔgɔ don kɔfɛ, I bɛ bin ŋɔ juw kɔrɔ, walasa nɔgɔ b***ɛ se*** ka sɔrɔ ka da tugu cogo min.

-URE kilo 50 taari kelen: URE In bɛ don ŋɔ ju kɔrɔ, ni ŋɔ faleni ye tilen 45 sɔrɔ.

6- Danni waati ani Danni kɛ cɔgɔ :

- danni waati :

danni kɛ waati bɛ bɔ cikɛ da cogola.

- Danni kɛ cogo :

Kenike walima ni ŋɔ gon cɛ ka kan ka kɛ mɛtɛrɛ 0,75 ; ŋɔ sunw minnu bɛ walan kelen kan, ani ŋɔ gon ka kan kɛ mɛtɛrɛ 0,5.

7- ŋɔ sun farali :

ŋɔ sun farali bɛ kɛ dɔgɔ kun 2 walima 3, ŋɔ faleni kofɛ. ŋɔ sun hakɛ taari la bɛ taga ŋɔ sun 53600 ha na sɔrɔ i ye farlenbɛ ka tɔto ŋɔ ju filan la ye.ni ye farali kɛ ka ŋɔ juw to saba sabaye, taari kelen ŋɔ ju bɛ ta jɔ sun 80400 la.

8- ladon cogo(dannifinw ladon cogo)

Walasa bin jugu kana se sɔrɔ ŋɔ kan, I ka kan ka foro siŋɛ o bato foro bɛ saniya, ŋɔ bɛ balo ka ŋɛ ani yelen bɛ don a kan ka mɔn ja.

9- lakanan cogo(Danni finw lakana cogo)

ŋɔ wili tɔ la bɛ se ka gɛlɛya dow sɔrɔ i na fɔ : bana bɛ se ka ŋɔ fura buru min nen wallima a tizan, bigun bɛ se ka da a la walima bana wɛrɛw.ni aw ye ni gɛlɛya min dɔ ye aw ka sigida la, aw ka kan kaw sen fo jona ka se ca kɛ da man, min ka baara ŋɛsin nedon ŋɔsi walan ka talima walasa u ka se ka fɛrɛ jɔnjɔnw ***ta ka gɛlɛya ninnu kɛlɛ.***

10- sɔrɔ jate mine li kɛnɛ kɛrɛkɛrɛ nen kɔnɔ "carres de rendement et estimation des rendements »

Walasa ka sɔrɔ jateminɛ, i bɛ cikɛla 10 ta. Cikɛla kelen o kelen, i bɛ taari kelen ta.taari seleken naani kelen kelen bɛɛ la,i bɛ kɛnɛ dɔ suma, min fan naani jayan bɛ yɛ kelen ye. A kɛnɛ boyan ka kan ka kɛ 5m 5m.i tila kana kɛnɛ ŋɔngon suma taari kelen in cɛman cɛ fana nan. O kɔrɔ ye, taari kelen kɔnɔ, i ka kan ka kɛnɛ duuru(5) de suma, seleke naani ani cɛmancɛ. Cikɛ da kelen nan, i bɛ ci kɛ la 10 ta. Cikɛ da kelen kɔnɔ,i ka kɛnɛ sumanlen ka kan ka bɛ kɛnɛ 50 man.kɔlɔ sikɛla ka kan ka mi kunafoni ninnuw ta a ka kɔlɔ sili kaye kɔnɔ : tizan hakɛ, tizan giriya, ani ŋɔ kisɛ giriya ŋɔ gosilen kɔfɛ.

11- ŋɔ tigɛli :

Ni ŋɔ kisɛ kɔkɔla, ***ŋɔ bɛ tigɛ.ŋɔ tigɛlen man kan ka da duguma, a ka kan ka da ŋɔ kala de kan walima fin wɛrɛw ina fɔ ga ta. Ni bɛ ka sababuye ka cincin bali ka don ŋɔ nan.***

12- ŋɔ gosili :

ŋɔ gosila, cikɛla bɛ se ka ŋɔ gosi ni ŋɔgosi masin ye, bere bese ka kɛ ka gosi, walima a bɛ se ka susu kolo kɔnɔ ni kolo kalan ye.ŋɔ gosi kɛnɛ ka kan ka lasaniya.aw ka kan ka basi da duguma walasa ŋɔ kisɛ kana se duguma walima fin wɛrɛw kana ŋagami ŋɔ kisɛ la.

A y'abila aw hakila sanka ni waati bɛ, ko laŋini ye ŋɔ kisɛ jɛlen ka se ka sɔrɔ walasa danfara bɛ se ka don cikɛla mi tow cɛ cogo mi sɔrɔ ko fan fɛ.ɔ

II- ŋɔtikɛlen kɔfɛ fɛrɛw :

1-ŋɔ mara yɔrɔ :

A ye bɔrɔ lasago cogo labato. ***A bɛ jiri dow da duguma, walasa bɔrɔ kana da siman kan. A bɛ tɛmɛ sira bila ŋɔ bɔrɔ siraw ni ŋɔgon cɛ walasa ŋɔ*** mara yɔrɔ ka se ka saniya ani fura ***kɛli ka nɔgɔ ya.***

2- ŋɔ bɔrɔ"ENSACHAGE"

bɔrɔ mana lamanw ye u da yira ŋɔ mara kɔ barisa fin ŋanamanw bɛ se ka don a le konɔ.bɔrɔ minnuw kaŋi ŋɔ mara la o ye bɔrɔ « PICS » ni bɛɛ ba do ni sɔ mara bɔrɔ. a bɔrɔ bq se ka ***ŋɔ kisɛ yɛrɛ mara ka se waati jan man.(kalo 6 ŋɔ)***

3-ŋɔ sɛgɛsɛgɛli :

Cikɛla bɛ kelen kelen tɔgɔ bɛ sɛbɛn a ka bɔrɔw kan. ŋɔ bɔrɔ damado bɛ suganti ŋɔ bɔrɔ maralen ninnuw cɛ man (kɛmɛ kɛmɛ sara la, ŋɔ bɔrɔ 10).ŋɔ bɔrɔ sugantilenw minnuw bɛ sɛgɛsɛgɛ walasa ka :samaya hakɛ don, ka cincin, bɛlɛ ani ŋamaŋama wɛrɛw hakɛw don.ni kunnafoni sɔrɔlen bɛ dajiri sanikɛlaw la.

III- <u>feere kɛ cɔgɔ fɛɛrɛw :</u>

1- ka sɔngon bila ka jigi ŋɔ tigɛ waati gɔnɔ:

Cikɛ tɔn bɛ cikɛlaw dɛmɛ k'u ka ŋɔ tigɛw kɔfɛ.

2- ka sumajɛlen feere ani ka sɔngon ba wajibiya:

Walasa ka suman jɛlen sɔrɔ, cikɛlaw bɛ fɛɛrɛ caman kɛ ina fɔ(basi, ŋɔgosi masin, walima ka suman bila fin sanfɛ min bato a tɛ se duguma).cikɛlaw bɛɛ fanabɛ ŋɔsi suguya kelen sɛnɛ. Cikɛ tɔn bɛɛ sɔngon ba wajibiya, suman finw kan minnow jɛlen don kosɛbɛ(dɔrɔmɛ naani bɛ ka ye ani tɔw cɛ).

3- ka kɛ jago kɛlaye ani ka feere kɛ sugula sɔngɔn ŋuman na:

Sugu kuraw bɛ k'u kunbɔ.cikɛ tɔn bɛ ka kɛ jɛgo kɛlawye. Min bolo ŋɔ marali ka nɔgɔ ani bɛ se ka hakɛ caman feere bayɛlɛmali kɛlaw ma, walima bagan balo bayɛlɛmalikɛlaw ma,walima Kaman ma finw tigiw ma.ni cikɛ tɔn bɛ wili ka sugu ŋini(sanikɛla) a yɛrɛ ye, o bato sɔngon ba bɛseka sɔrɔ, sumanw na.

4- ka cikɛ tɔn kɔkɔrɔmadon walasa a ka se ka suma feere songon ba la ani a kase ka nɔgɔ san ka di tɔn denw ma.cikɛ tɔn bɛ ŋɔ mara ka sɔrɔ ka feere kɔfɛ(awirili walima kalola). A bɛ sanni kɛla ŋini. A bɛ se ka sɔngon ba sɔrɔ, ni marali kantaala jayan nan.walasa ka nɔgɔ sɔngon nɔgɔya, cikɛlaw ka kan ka sanni kɛ bakurubala.

IV- cikɛ tɔnw kɔkɔrɔ ma doni :

Walasa cikɛlaw ka sɔngon ba sɔrɔ ***feere finw na sugu la, fo u ka hakilijagabɔ kɛ feere finw kan minnow jɔy***ɔrɔ ka bo kos***ɛbɛ.a bato u bɛ se ka nɔgɔ fana sɔrɔ sɔngɔ nɔgɔn nan. Ni cikɛ tɔn kɛra kooperatifu, hakilijagabo, sigikafɔ,kumanŋɔgoya bɛ nɔgɔ ya u ma.***

1- cikɛ tɔnw walanka tali :

Cikɛ tɔn besigi dugu kelen kelen man walima tɔn min dugu kɔnɔ kɔrɔlen, ko kɔrɔkɔrɔ madon.

2- fɔɔn mara yɔrɔ ***jɔli :***

fɔɔn mara yɔrɔ ka kan ***ka jɔni ŋɔ mara y***ɔrɔ ***teyi, anw bɛ wilika jɔ kɛ ka dɛmɛbaga ŋini o ka dɛmɛ a jɔli la.***

3- suma jɛlen ani tɔn denw ka juru sarali tigiya bɛ tɔn de kan:

tɔn koŋanabobagaw ka kan ka jɔ tɔn nɔgɔ juru sarali kɔrɔ.

4- tɔn bɛ se ka juru sɔrɔ ka di tɔn denw ma :

tɔn bɛ baara kɛ ŋɔngon ya ŋini ni sigida wari bo dɔwye. A bɛ kontɛ dayɛlɛ ye tɔn tɔgɔla. O baarakɛ ŋɔngonya bɛkɛ sababuye mininuw bɛ se ka nafolo ladon tɔn kun.cikɛ tɔn kolo giri bɛkɛ sababu ka se ka feere ka sɔngɔn ba sɔrɔ ani ka juru sɔrɔ wari bonw na walasa ka nɔgɔ san.

III- ŋɔ***si b***ɔ ***:***

Ni kɛnɛ sɛnɛ tola kaboyan ka ta , a bɛ kɛ sababuye kagɛlɛya don ŋɔsi ŋuman sɔrɔli la.

1- ŋɔsi bɔli togodala cikɛlaw fɛ :

Ni kɛnɛ sɛnɛ ta tɛmɛ taari kɛmɛ caman kan , hakili ka kan ka to ŋɔsi sɔrɔli sanga ni waatibɛ. O la cikɛlaw dow ka kan ka kalan ŋɔsi bɔlila.sɛnɛ fɛɛrɛ ŋɛndon cakɛda sen bɛ don cikɛlaw ninnuw kalan ni na.ŋɔsi ni ka kan ka sɛnɛ cikɛlaw san 3 ŋɔngon.san 3 kɔfɛ, a ba sɔrɔ ŋɔsi ŋagamina kosɛbɛ sigida ŋɔsiw tɔ la.

2- ŋɔsi bɔli tɛmɛ siraw :

Ka foro mabɔ tow la, ka si juguw faga kabɔ tɔw cɛla, ka kɔlɔ sil ;i caya walasa ŋɔ bɛ ka kɛ suguya kelen ye.

3- ka si ŋuma feere sɔngon ba la :

ŋɔsi sɛnɛ bɛ timinanja, ka ta danni waati, ka ta se si jugu fagalima, ani fo ka ta se ŋɔsi lasagolima, ka kan ka sara. O de la ŋɔsi sɔngon ka kan ka caya walasa ka kɛyɛrɛyew fana sama ka don a la.

<u>ŋɔsibɔ n'a feere cɔgɔ</u>:
walasa ni gafe ka matarafa sɛnɛkɛlaw bolo ani u ka se ka nafa caman sɔrɔ u ka baarala fɔ sɛnɛkɛlaw ka tɛmɛ siraw dowfɛ:

I-<u>ŋɔsibɔ n'a feere gafe matarafali:</u>

1- gafe ba wajibiya sɛnɛkelaw ka baara kɛ ni nɔgɔ, basi ani saki ŋumanwye walasa u ka nafa sɔrɔ ŋɔbɔ la.

2- ka juru ŋini kɛsuw walima bankiw fɛ.

3- sɛnɛkɛ jɛkulu kakan ka binka sɛbɛn kɛ ani u ka sannikɛlawcɛ.walasa ka juru sɔrɔ bankiw la.

4- o bɛnkan sɛbɛn bɛ talikɛ ŋɔsi cɔgɔya kan, ŋɔsi suguya kan.

5- ŋɔ songɔn sugula ani ton ka songɔn ka kan ka kɛ bɛnkan na o bato banki ka juru bɛ sarajona.

II- <u>ka dɔfara tonɔ kan:</u>

1- sɛnɛkɛlaw bɛ baarakɛ ni ŋɔsi kuraye ani ŋɔgɔ kofolenye. ***u bɛ poroze lasiden ka ladilikanw namɛ.***

2- u bɛ ŋɔsi jɔnjɔn sɛnɛ ka kɛŋɛni bɛnkan sɛbɛnye.

3- sɛnɛkɛlaw bɛ feere ŋuman labato walasa u ka ŋɔsi jɛlen sɔrɔ.i na fo basi.

4- ton bɛ ŋɔsi jɛlenw fara ŋɔgon kan k'o lamara kaŋɛ walasa ka ŋɔ caman feere ŋɔgɔnfe.

5- o feere bato ubɛ nafa sɔrɔ u ka ŋɔsi la.

6- ton bɛ feerew kɛ walasa ka sanni kɛla caman sɔrɔ sugu konɔ. O bato u tɛ dan sanni kɛla kelen ma. O la tono caman bɛ sɔrɔ.

7- sanni kɛlaw sugu yaw ka ca: suma bayɛlɛmalaw, isini tigiw, walima guvernema mɔgɔw (PAM, CRS, OPAM).ton

bɛ se ka ŋɔ feere mɔgɔw wɛrɛw ma ni ka sɔrɔ u ben na a songon kan.

III- <u>ka ton k***ɛ ton ladiriye***</u> ***:***

1- ton denw ka kan ka kɛ mɔgɔ ladiriye. U ka kan ka ŋɔsi ŋuman sɛnɛ, ka nɔgɔ ŋuman ŋini ŋɔgɔnfe walasa u ka na musaka caman bɔ. ton ka kan ka juru ŋini bankiw fe.

2- ka koperatifuw kalen walima caman sigi duguw bɛla. Ani ka wɔlɔ sɛbɛn ŋini a kelen kelen na.

3- magazan ye wajibiye o bato ton bɛseka ŋɔ caman feere ŋɔgonfe.

4- ton wari maralaw ka baara doye juru kani ye walasa ka se ka ŋɔgɔ san.

5- walasa ton ka kɛ ladiriye fɔ baaraw ka kɛ jɛlen yala ani yon kase ayɛrɛkɔrɔ. ton ka kan ka kalan ŋini I nafo:
-baara kɛ cɔgɔ ŋuma
-gafew dilanni walasa ka jatew sinsɛ
-kunnafɔniw sɛbɛnniw
-ka danfarakɛ ton musakaw ani musaka wɛrɛw cɛ.

6- ton ka kan ka sariyaw sigi ani bɛnkanw ka talikɛ koperatifu ka sariya gafe ye. O sariya gafe bɛ wele ko (OHADA). O wajibiyalan bɛ sɛnɛkɛlaw kan. Sɛnɛkɛ ton bɛ ka kan ka a ka sariyaw sigi, ka lajew bɔlɔ da o ye wajibiye ton bɛɛ kan.

FICHE DE PRODUCTION ET DE COMMERCIALISATION DU MIL

Botorou Ouendeba, INTSORMIL; Niaba Teme, IER et l'equipe de IICEM
Avril, 2011

FICHE DE PRODUCTION ET DE COMMERCIALISATION DU MIL
Avril 2011

I. Agronomie

1.1 Zone de production et choix du champ paysan

- Zone de production : pluviométrie allant de 400 à 800 mm
- Choix du terrain : Le champ choisi **ne doit pas être un champ pauvre ou marginal**. Le sol du champ doit être de type sablonneux ou sableux-limoneux

1.2 Préparation du sol

Le semis se fait à plat après grattage ou sur nouveaux ou anciens billons après une pluie de 20 mm. Eviter des equipements lourds sur les sols sablonneux.

1.4 Traitement de semences.

la semence doit être traitée avec un fongicide insecticide (un sachet d'Apron star pour 10kg de semence) ou suivant l'indication du fabriquant.

1.3 Quantité de semence à l'hectare : 8 **-** 10 kg/ha ; de préférence 10 kg en cas de ressemis.

du fabriquant.

1.5. Doses et Application d'engrais

- **Apport de 50 kg/ha de DAP :**

Le DAP est apporté au niveau des poquets suivi d'un sarclo-binage pour couvrir l'engrais pour éviter des pertes.

- **Apport de 50 kg/ha d'Urée** : L'urée est apportée autour du poquet 45 jours après la levée ; cet engrais est **enfoui** dès son épandage.

1.6. Date et densité de semis

- **Période de semis** : La période de semis est spécifique à la zone de production
- **Densité de semis**

Un semis en ligne est recommandé. Les écartements sont de 1 m entre deux lignes et de 1 m entre deux poquets sur les sols sablonneux (1 m x 1 m = 10000 poquets par ha) ; pour les sols sablo-argileux la densité est plus élevée : 1 m x 0.75 m soit 13333 poquets par ha.

1.7. Démariage

Le démariage se fait deux à trois semaines au plus tard après la levée et il se fait à 3 plants poquet.

1.8. Entretiens culturaux

Le champ doit être maintenu propre : 2 sarclo-binages au minium ; l'entretien se fait à la demande.

1.9. Protection des cultures

Au cours de la croissance végétative les cultures sont souvent soumises à des pressions parasitaires telles que les maladies foliaires et les insectes floricoles. Les services compétents de l'Agriculture doivent être informés à temps.

1.10. Carrés de rendement et estimation des rendements

Trois carrés de rendement de 5m x 5m chacun sont placés dans un hectare chez un producteur. Il faudra prévoir un carré à chaque coin de l'hectare et un autre au milieu du même hectare. Dix producteurs seront choisis par zone. Après la récolte de chaque carré, le nombre d'épis, le poids d'épis et le poids de grain après battage sont reportés dans le

cahier des observations de l'agent chargé du suivi**.** Trois autres carrés seront placés dans le champs du même producteur, mais qui est semé avec sa variété locale et travaillé avec les techniques traditionnelles du producteur.

1.11. Récolte

Les épis récoltés ne doivent pas être déposés à même sur le sol ; au fur et à mesure que la récolte se fait, les épis doivent être placés sur les tiges mis sur le sol pour la circonstance. Cette pratique est très courante chez les producteurs. Il vaut mieux avoir du mil dépourvu de grains de sable que d'avoir à faire le nettoyage au moment de la transformation.

1.12. Battage

Pour le battage, les producteurs peuvent utiliser une batteuse à mil, des mortiers avec pilons ou avec des bâtons sur des aires ou sont étalées des bâches pour éviter que les grains ne touchent le sol ou d'autres impuretés.
Il faut toujours garder à l'esprit que l'un des objectifs du programme est d'avoir un produit final (grains) très propre et de bonne qualité qui doit conduire à l'obtention d'un premium pour les paysans auprès des acheteurs.

II. Techniques Post-Récolte

2.1. Magasin

Respecter le dispositif recommandé pour le stockage des sacs; utiliser des palettes pour éviter que les sacs soient à même sur le ciment ; laisser des allées entre les piles de sacs afin d'y pouvoir circuler librement à l'intérieur du magasin et si nécessaire faire des traitements contre les insectes.

2.2. Ensachage

Les sacs plastiques normaux ont montré leur limite concernant les attaques d'insectes de stockage. La solution serait d'utiliser des sacs PICS connus pour stocker des grains de niébé et certainement des grains de céréales pour une longue durée (plus de 6 mois).

3.3. Contrôle de la qualité des grains

Tous les sacs amenés par les producteurs vont porter les noms de ces producteurs pour s'assurer de la traçabilité des grains. Un échantillonnage est fait au niveau des sacs stockés (10% du stock total) dans le magasin de la coopérative. Ces échantillons (3 échantillons par sac) seront analysés pour déterminer l'humidité et les taux d'impuretés (sable, cailloux, débris végétaux et autres matières inertes). Ces informations sont mises à la disposition des acheteurs.

III. Stratégies de commercialisation

Pour tirer profit de leurs productions, les paysans doivent adopter les stratégies de commercialisation proposées par le projet Marketing.

3.1. Eviter la chute de prix à **la récolte**

L'association des producteurs doit prendre toutes les dispositions utiles pour que les grains stockés dans leur magasin soient vendus plus tard après les récoltes mais avant le début de la campagne suivante (avril). C'est en effet à cette période que les prix des céréales sont plus élevés.

3.2. Vendre des céréales propres et exiger un sur- prix

Les producteurs individuels utilisent des techniques (bâches, batteuse, tout en gardant les céréales au-dessus du sol)pour produire des céréales propres. L'association des producteurs pourrait ainsi exiger un premium de qualité pour leur céréale propre.

3.3. Devenir commerçant et vendre sur le marché à un meilleur prix

Avec la politique de valorisation des céréales locales, on assiste à un développement de nouveaux marchés de céréales (grandes unités de transformation en milieu urbain) ; si les associations des producteurs disposent de bonnes facilités de stockage pour stocker, de grandes quantités de grains peuvent être vendues à ces unités de transformation. En éliminant les intermédiaires, on pourrait obtenir des pris très élevés.

3.4. Encourager les associations de producteurs à vendre des céréales à un bon prix et à acheter des intrants pour ses membres

L'association des producteurs stocke de grandes quantités de céréales et les vend plus tard (avril - mai). Tout en ayant des informations sur l'évolution des prix de céréales sur les marchés, l'association cherche des acheteurs disposés à payer un prix premium. A l'approche de la campagne, les producteurs peuvent faire un achat groupé des intrants pour bénéficier d'une réduction des prix des intrants.

IV. **Renforcement des associations de producteurs**

Les producteurs ont besoin d'une association forte, crédible avec une gestion transparente de leurs affaires quotidiennes. Ils vont donc développer un pouvoir de négociation en offrant des produits compétitifs pour avoir des prix élevés dans la commercialisation (et aussi pour obtenir à l'achat des coûts d'intrants réduits). En développant des coopératives de commercialisation, les producteurs vont acquérir cette capacité de négociation.

4.1. Développement des associations de producteurs

Dans chaque village une association de producteurs est initiée ou bien le groupement existant est renforcé

4.2. Construction de magasin

Des magasins de stockage sont nécessaires ; s'il n'y en a pas nous allons aider à chercher des bailleurs de fonds intéressés à faire l'investissement dans la construction.

4.3. L'association est responsable de la production de céréales propres et du remboursement de crédit de ses membres

Les gestionnaires de l'association doivent être responsables du remboursement par ses membres, des crédits pris pour l'achat des intrants utilisés dans la production. Ces crédits doivent être en nature et remboursés après la récolte en fonction du prix du mil dans la localité.

4. L'association obtient du crédit pour ses membres

L'association développe des relations avec une banque ou une institution de micro-finance de proximité par l'ouverture d'un compte au nom de l'association. Cette relation va favoriser l'octroi de prêts pour faire du warrantage ou d'autres activités génératrices de revenus pour l'association. Une organisation de producteurs forte conduit à des prix élevés et facilite aussi l'accès aux crédits bancaires donc aux engrais.

V. Production de semences

Au fur et à mesure que les superficies emblavées deviennent importantes avec le programme d'extension, la production et l'approvisionnement en semences de qualité peuvent constituer un frein à cette expansion des superficies de mil.

5.1. Production de semences au niveau des producteurs locaux

Au delà de plusieurs centaines d'ha, il faut commencer à assurer un approvisionnement régulier de semences des variétés adaptées en formant des paysans semenciers pour produire des semences certifiées en étroite collaboration avec les services compétents de l'agriculture. Ces semences devraient être utilisées par les producteurs annuellement ou au plus pendant 3 ans dans les conditions extrêmes. Au delà de 3 ans, le pourcentage de mélanges avec les autres variétés cultivées dans la zone devient important. L'arrivée prochaine en milieu paysan de cultivars hybrides va augmenter de manière significative la productivité et la production de mil.A l'inverse de ce qui se passe avec les variétés, chez les hybrides les semences doivent être renouvelées chaque année. La formation des producteurs semenciers entreprise avec les variétés facilitera la production de semences hybrides en milieu paysan.

5.**2. Conditions de production de semences** :

La parcelle de production de semences de mil doit être distante d'au moins 300 m d'un autre champ de mil. Un passage dans la parcelle de semences, tous les 2 ou 3 jours au début de l'épiaison, pour éliminer les plantes hors-types est nécessaire. Il faut s'assurer d'un suivi rapproché pour contrôler l'homogénéité du cultivar.

5.3. Payer un bon prix pour les semences de qualité.

L'effort fourni par le producteur semencier depuis les semis jusqu'à l'emballage en passant par l'élimination périodique des plants hors types, doit être récompensé. C'est pour quoi il est nécessaire que le prix de semence obtenu à la vente soit incitatif, condition essentielle pour attirer le secteur privé sans lequel il sera difficile de développer le secteur semencier.

Adoption, du paquet, Maximiser le revenue et et crédibiliser l'organisation paysanne

Pour favoriser et assurer l'adoption du paquet technologique (fiche de production du Mil) et permettre la maximisation des prix pour les paysans, il y a lieu de procéder en plusieurs étapes. Cela pérennisera la stratégie sur une base d'affaires.

I. Adoption du paquet technologique

1. Le paquet technologique exige l'utilisation optimale des intrants (fertilisants et semences améliorées) et des outils post récoltes (bâche et sacs appropriés d'ensachage).
2. Les organisations de producteurs qui ne possèdent pas de fonds de roulement suffisant pour appliquer ce paquet technologique doivent chercher des prêts/crédits auprès d'une institution financière.
3. Les institutions financières exigent habituellement une garantie (financière ou physique). A défaut, les organisations paysannes doivent avoir dans leur demande de financement un contrat d'achat dûment signé avec un commerçant ou une entreprise connue de la place.
4. Le contrat d'achat comporte un cahier de charge incluant des critères de qualité de la céréale : variété, humidité, taux d'impuretés.

5. Le contrat d'achat comporte le prix du marché plus un premium pour la qualité. Le contrat avec le remboursement direct payera l'emprunt de l'institution financière. Ce système permet d'utiliser le paquet technologique et aussi d'assurer le remboursement rapide de l'emprunt. Les excédents céréaliers qui restent peuvent alors s'inscrire dans la stratégie de maximisation de revenu.

II. Maximiser le revenu

1. Les producteurs utilisent l'ensemble des semences améliorées et des fertilisants sur les hectares faisant l'objet du paquet technologique. Ils respectent l'itinéraire technique et les conseils agronomiques (fiche de production et de récolte du Mil).
2. Les paysans sèment une variété uniforme, selon le cahier de charge du contrat.
3. Les producteurs individuels utilisent des techniques (bâches, batteuse, séchage des épis au-dessus du sol) pour produire des céréales propres.
4. L'organisation paysanne regroupe les céréales propres et les stockent dans un entrepôt adéquat. Les volumes stockés permettent de négocier en gros, ouvrant de nouveaux marchés.
5. Les volumes en gros de céréales propres dans un conditionnement et un entrepôt adéquat permettent d'obtenir une prime sur le prix du marché local, maximisant la marge de revenu des producteurs.
6. L'organisation paysanne développe une stratégie de vente à plusieurs acheteurs et segments de marché. Cette stratégie de diversification des ventes diminue les risques de concentration sur un seul acheteur et assure la maximation du prix de vente.
7. Les différents acheteurs et segments de marché sont principalement: les petits transformateurs (alimentation humaine), les appels d'offres des organisations internationales et du gouvernement pour combler leur besoin en sécurité alimentaire (PAM, CRS, OPAM, Commissariat à la sécurité alimentaire, etc.) et les appels d'offres des grands moulins et commerçants. L'association des producteurs peut aussi vendre à son acheteur «de sécurité » si les parties s'entendent sur le prix de vente.

III. Crédibiliser l'organisation paysanne

1. Les producteurs ont besoin d'être crédibles : vendre des produits recherchés et compétitifs pour avoir des bons prix, acheter les intrants en gros pour bénéficier d'une réduction du coût et finalement, obtenir le financement nécessaire auprès des institutions financières. En développant des coopératives crédibles, les producteurs vont acquérir une force de négociation.
2. Dans chaque village, une ou plusieurs coopératives sont mises en place, avec un récépissé légal.
3. Des magasins de stockage sont nécessaires afin de dégager des quantités suffisantes permettant de développer des marchés de gros.
4. Les gestionnaires de l'association doivent être responsables du remboursement des crédits qui sont utilisés plus tard pour l'achat des intrants (semences, fongicides et engrais)
5. Pour assurer la crédibilité des organisations de producteurs, il faut une bonne gouvernance, une meilleure organisation et une autonomie financière. Les organisations de producteurs devront rechercher les connaissances et les habiletés suivantes:
   - Mécanisme de gestion, par des outils simples de comptabilité et de transparence
   - Mécanisme de capitalisation et de génération des ressources propres, par la distinction entre part sociale de l'organisation et les capitaux des activités économiques de l'organisation;
6. La coopérative - et règlements, réunion statutaire, exigence de la loi en termes de gestion

FICHE DE PRODUCTION ET DE COMMERCIALISATION DU MIL

DOGON VERSION OF THE MILLET PRODUCTION MANUAL FOR NORTHERN MALI

saŋɔ baara cogo n'a feere cogo gafe:

mogo minuwye gafe dilan oye:

botoru wamdeba, ŋaba tɛmɛ ani "iicem"

baara kɛlaw, awirili kalo san 2011

Dɛmɛbagaw ye:

USAID

IER

INSORMIL

IICEM

saŋɔ baara cɔgɔ n'a feere cɔgɔ gafe

Awirili kali, san 20011

I. ***-kalan minbɛ talikɛ anka sumansiw baara cɔgɔ ŋɔmankan:***

1-1 ***a baara yɔrɔ*** **ni foro sugandili**

-a baara yɔrɔ : sanji hakɛ *minbate milimɛtɛrɛ 400 kalila milimɛtɛrɛ 800ha.*

-fɔrɔ su*gandili cɔgɔ* : a kakɛ *fɔrɔye min ma sɛgɛn.cincin bɛɛ dungukolo min'a.*

1-2 <u>dugukolo la baara cɔgɔ *:*</u>

*Damni ka kan ka kɛ dugukolo kura kan walima k*ɔrɔlen kan sanji milim*ɛtɛrɛ 20 nalenkɔ.*

Da ankana minɛw girimanw kɛka baarakɛ

1-3 <u>ŋɔsi hakɛtaarila</u>:

Kilo 8 walima kilo 10 taara kelen:ŋa n'abifɛ ka Danni kuraya a kakan an ka kilo 10 ta.

1-4 <u>ŋɔsi furakɛ cɔgɔ</u>:

<u>ŋɔsi kakan ka furakɛ ni"apron star"ye.</u>

A baara cɔgɔ ŋɛfolendon a bidon kan.

1-5 <u>nɔgɔ hakɛ an'a kɛ cɔgɔ</u>:

*"dapu"bekɛ suman kɔrɔ katila ka k*ɔrɔ si*ŋɛ walassa suman ka nafa sɔrɔ.*

-"ire" kilo 50 taarila: ire bikɛ tile 45 don ŋɔwilen kura.

1-6 <u>danni waati n'a kɛcɔgɔ:</u>

-danni waati: Danni waati bɛ talikɛ yɔrɔ cɔgɔyala.

-danni cɔgɔya :

Laŋini ye ka dannikɛ turi tilinew kan. mɛtɛrɛ kelen(1) ka kan kabila turiw ni ŋɔgɔnɔɛ. o mɛtɛrɛ kelen ka kan ka bila fana ŋɔ dan new ni ŋɔgɔcɛ cɛncɛn bɛɛ dugukolo min'a. o jate ka kan ka ben ŋɔ sun

10000 taari kelen wo taari kelen.bɔgɔ ni cɛncɛn ka ca dugukolo min'a o jate ye ŋɔ sun 13333 taari kelen wo kelen.

1-7 <u>ŋɔ sun bɔli ŋɔgonna :</u>

Obaara bi kɛdɔgɔkun saba ŋɔsi wililenkɔ.

1-8 <u>fɔrɔ baara cɔgɔ ŋuma</u> :

Fr konona kakan kajɛ.k'a kɔrɔ siŋɛ siŋɛ 2 ŋɔgon. Ŋa ni baara kɔfolen bɛɛkɛ fɔrɔtigi ka yamariya komɔ.

1-9 <u>suman kolo sili cɔgɔ</u> :

ŋɔ dannewnw bɛɛ gɛlɛya caman sɔrɔ **ufalen waati. O g***ɛlɛyaw bɛɛ talikɛ banaw la walima fenwɛrɛw min n'u bɛɛ dan kari u balo cɔgɔ ŋɔ***man na.***o la an kakan kawelebila jɔna baarada min ŋɛsilindon sɛnɛ ma.*

1-10 <u>sɔrɔw jateminɛli</u>:

"carre"saba n'o bibɛn (5m 5m) a kelen wo kelen taari kelen kɔnɔnala. An kakan ka"carre "kelen laben fɔrɔ selekɛ kelen wo kelen n'a. o kofee an bɛɛ "carre" kelen laben foro camacɛ fɛnɛna.katila ka sɛnɛkɛla 10 ta.ŋɔtigɛ kofɛ, ŋɔni hakɛ n'a giriŋa, ŋa si koro dehe dan o kono.

1-11 <u>ŋɔtigɛ</u>

"cpis" man kan tɛ kabila guguma.an kakan ka bila ŋɔkalaw sanfe.

1-12 <u>ŋɔgosi:</u>

Sɛnɛla bise ka ŋɔgɔsi masin walima ka ŋɔ susu kɛ kolon kɔnɔ o baato ŋɔ tɛnɔgɔ .

II. Fɛɛrɛw ŋumanw ŋɔtigɛ tɛmɛnen ko :

2-1 <u>magasan :</u>

Walassa an ka ŋɔ ka lamara kaŋɛ, an ka kan fɛɛrɛw dow sigi sen kan :
O fɛɛrɛw dow ye :
-ka ŋɔw bila jiriw sanfe walasa a ka nase sima ma.
-ka tɛmɛsiraw bila magasan kɔnɔ walasa kolosili nɔgɔya.

2-2 <u>ŋɔbila cɔgɔ bɔrɔ kɔnɔ:</u>
ŋɔ ka kan ka kɛ bɔrɔ kɔnɔ n'u ba wɛle "pics". ŋɔ loise ka mara o bɔrɔ kɔnɔ fokalo woro(6) ka sɔrɔ fen ma soro.

3-3 <u>ŋɔ ŋuman sɛgɛsɛgɛli</u> :

bɔrɔ tigiw tɔgɔ bɛɛ sɛben bɔrɔw sanfe walasa ka danfara don ŋɔ nalenw ni ŋɔgɔnce.o kɔfɛ sɛgɛsɛgɛli bɛɛkɛ walasa ka ŋɔ ŋumanw sugandi. O kunnafoni sanni kɛlaw ma.

III. <u>ŋɔ feere cɔgɔ walasa ka nafa sɔrɔ:</u>

walasa ka nafa sɔrɔ an ka ŋɔ la, an ka kan kaporoze ka feereɛ latama ani k'u labato.

3-1 <u>an ka na ŋɔ sangɔ nagasi ŋɔtigi kɔ:</u>

Sɛnɛkɛla jɛkuluw ka kanka u ka ŋɔ feere ŋɔtigɛw tɛmɛnɛnw kɔ. o feere ka kan ka kɛ sanni awirili kalo cɛ. abasɔrɔ samiya kura mase fɔlɔ. o waati basɔrɔ ŋɔ songon kaŋi kɔsɔbɛ.

3-2 <u>kakɛ ŋɔ feerela jɔlenye ani ka nafa sɔrɔ ika baara la:</u>

Nisɛnɛ kɛ jɛkuluw sera k'u ka sɛnɛkɛ finw lamara kaŋɛ obɛkɛ sababuye ka u ni suman bayɛlɛmalaw bɔlɔdon ŋɔgonbɔlɔ. a bɛkɛ sababuye tuguni u ka nafa sɔrɔ u ka baara la.

3-3 kaŋɔsi ŋumanw sugandi walasa ka wari caman sɔrɔ:

Kɛŋɛrɛyɛ sɛnɛkɛlaw bɛɛ u ka ŋɔ bila basi kɔnɔ walasa a ka n'a nɔgɔ.sɛnɛkɛla jɛkuluw fana bɛ se ka feere kɛ walasa u ka ŋɔ ka na nɔgɔ.

3-4 ka sɛnɛkɛ jɛkuluw la famuya walasa u ka ŋɔw feere songo ŋumanla o bato u bɛseka nɔgɔ san u ka ton denw ye:

Sɛnɛkɛ jɛkuluw bɛɛ ŋɔ caman mara ka tila ka feere sani awirikali ni mɛkalo kase. O basɔrɔ u ye kunnafoni jɔnjɔn sɔrɔ ŋɔ songon kan sugu kɔnɔ. u bɛɛ sɔrɔ kan sanni kɛla jɔnjɔn ŋini walasa k'u ka ŋɔw feere sɔngɔ ŋumana.samiya kura m'a na suruya sɛnɛkɛlaw jɛkuluw bɛɛ seka fara ŋɔgɔn kan walasa ka nɔgɔ san.o baato u ka wari bɔɔta bɛɛ nɔgɔya.

VI *Ka dɔfara sɛnɛkɛ jɛkuluw ka famuyali kan:*
Sɛnɛkɛ jɛkuluw ka laŋiniw ye k'u ka jɛ sinsi ani ka kɛ danaya jɛkuluye. O bato u bɛɛ nafa caman sɔrɔ u k'a baara la ani ka nɔgɔ san sɔngɔ duman na walasa o ka sabati, sɛnɛkɛ jɛkuluw kakan ka hakili falinw walasa k'a feere kɔperatifu sigi senkan. O n'a kɛ sababu ye ka famuyali sɔrɔ feere cɔgɔyaw kan.

4-1 sɛnɛkɛ jɛkuluw ka ŋɛtaa sabatili:

Ka fɛrɛ kɛ ka sɛnɛkɛ jɛkulu sigi duguw bɛɛ la.n'a bɛɛ dugu miniw la, ka kalan kɛ o jɛkuluw kunna walasa ka dɔfara u ka famuya kan.

4-2 magasan jɔ:

Magasan nafa ka bɔn kɔsɔbɛ.ka dɛmɛba kaw ŋini walasa ka magasan jɔ.

4-3 <u>sɛnɛkɛ jɛkulu dɔrɔn de yamariyalenbɛ ton ka ŋɔ baaraw ani tondenw ka juruw saraw ma</u> :

mɔgɔ miniw ka baara ye musaka kow ye ton kɔnɔ o mɔgɔw de yamariyalenbɛ ka duruw kani ton denw n'a. o jurubɛ nɔgɔ songɔw kan.ŋɔ debɛkɛ ka juruw sara. Jurubɛ sara ŋɔtigɛw bannew kɔ ka kɛnɛni ŋɔ songɔn ye o waati la an dugu kɔnɔ.

4-4 <u>sɛnɛkɛ jɛkulu be seka juru sɔrɔ bankiw fɛ ton denw tɔgɔla</u>:

Sɛnɛkɛ jɛkulu ka kan ka conti dayɛlɛ bankiw la walima kɛsuw la ton tɔgɔla. O bato u biseka juruw sɔrɔ. **ton biseka** *o wari kɛ ka baara wɛrɛw kɛ walasa ka dɔfara a ka sɔrɔ kan ani ka juru sɔrɔ ni nɔgɔyaye.*

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v- *<u>ŋɔsibɔ :</u>*

ni ŋɔ sɛnɛkɛnɛ boŋana cɔjugun obɛkɛ sababuye ka gɛlɛya don ŋɔsi ŋuman bɔɔli n'a feerelila.

5-1 <u>sɛnɛkɛlaw ka ŋɔsibɔ :</u>

Ni kɛnɛ sɛnɛtaa bɛ taari caman bɔ, a ka kan si ŋuman di sɛnɛkɛlaw ma jɔɔna.ani k'u kalan ŋɔsi baara cɔgɔ ŋuman na.sɛnɛkɛlaw ka kan ka ŋɔsiw labara san kelen konɔ walima san saba konɔ. San saba kɔfɛ, ŋɔsi kura hakɛ ani ŋɔkɔrɔ ŋagaminenbɛ fanga sɔrɔ kosɔbɛ. O bato dobifara sɔrɔ kan.sɛnɛkɛlaw kalanni obɛkɛ sababuye ka fangadi ŋɔsi ŋagaminen ma.

5-2 <u>ŋɔsi baara cɔgɔ</u> :

Mɛtɛrɛ 300 ka kan ka bila ŋɔforo ni ŋɔgoncɛ. An ka kan an ka foro kolosi tuma bɛɛ. Walasa k'a kisi binjuguw ma walima bana wɛrɛw ma.

5-3 <u>ton ka kan k'a ŋɔsiw feere songɔ ŋumana:</u>

Baara fen fen kɛra walasa ka ŋɔsi ŋumabɔ o bɛɛ ka kan ka jatimineen sani sɛnɛkɛla ka a ka ŋɔsi feere.

<u>ŋɔsibɔ n'a feere cɔgɔ</u>:
walasa ni gafe ka matarafa sɛnɛkɛlaw bolo ani u ka se ka nafa caman sɔrɔ u ka baarala fɔ sɛnɛkɛlaw ka tɛmɛ siraw dowfɛ:

I-<u>ŋɔsibɔ n'a feere gafe matarafali:</u>

1- gafe ba wajibiya sɛnɛkelaw ka baara kɛ ni nɔgɔ, basi ani saki ŋumanwye walasa u ka nafa sɔrɔ ŋɔbɔ la.

2- ka juru ŋini kɛsuw walima bankiw fɛ.

3- sɛnɛkɛ jɛkulu kakan ka binka sɛbɛn kɛ ani u ka sannikɛlawcɛ.walasa ka juru sɔrɔ bankiw la.

4- o bɛnkan sɛbɛn bɛ talikɛ ŋɔsi cɔgɔya kan, ŋɔsi suguya kan.

5- ŋɔ songɔn sugula ani ton ka songɔn ka kan ka kɛ bɛnkan na o bato banki ka juru bɛ sarajona.

II- <u>ka dɔfara tonɔ kan:</u>

1- sɛnɛkɛlaw bɛ baarakɛ ni ŋɔsi kuraye ani ŋɔgɔ **kofolenye.** *u bɛ poroze lasiden ka ladilikanw namɛ.*

2- u bɛ ŋɔsi jɔnjɔn sɛnɛ ka kɛŋɛni bɛnkan sɛbɛnye.

3- sɛnɛkɛlaw bɛ feere ŋuman labato walasa u ka ŋɔsi jɛlen sɔrɔ.i na fo basi.

4- ton bɛ ŋɔsi jɛlenw fara ŋɔgon kan k'o lamara kaŋɛ walasa ka ŋɔ caman feere ŋɔgɔnfe.

5- o feere bato ubɛ nafa sɔrɔ u ka ŋɔsi la.

6- ton bɛ feerew kɛ walasa ka sanni kɛla caman sɔrɔ sugu konɔ. O bato u tɛ dan sanni kɛla kelen ma. O la tono caman bɛ sɔrɔ.

7- sanni kɛlaw sugu yaw ka ca: suma bayɛlɛmalaw, isini tigiw, walima guvernema mɔgɔw (PAM, CRS, OPAM).ton bɛ se ka ŋɔ feere mɔgɔw wɛrɛw ma ni ka sɔrɔ **u ben na a songon kan.**

III- **<u>ka ton kɛ *ton ladiriye*</u>** *:*

1- ton denw ka kan ka kɛ mɔgɔ ladiriye. U ka kan ka ŋɔsi ŋuman sɛnɛ, ka nɔgɔ ŋuman ŋini ŋɔgɔnfe walasa u ka na musaka caman bɔ. ton ka kan ka juru ŋini bankiw fe.

2- ka koperatifuw kalen walima caman sigi duguw bɛla. Ani ka wɔlɔ sɛbɛn ŋini a kelen kelen na.

3- magazan ye wajibiye o bato ton bɛseka ŋɔ caman feere ŋɔgonfe.

4- ton wari maralaw ka baara doye juru kani ye walasa ka se ka ŋɔgɔ san.

5- walasa ton ka kɛ ladiriye fɔ baaraw ka kɛ jɛlen yala ani yon kase ayɛrɛkɔrɔ. ton ka kan ka kalan ŋini I nafo:
-baara kɛ cɔgɔ ŋuma
-gafew dilanni walasa ka jatew sinsɛ
-kunnafɔniw sɛbɛnniw
-ka danfarakɛ ton musakaw ani musaka wɛrɛw cɛ.

6- ton ka kan ka sariyaw sigi ani bɛnkanw ka talikɛ koperatifu ka sariya gafe ye. O sariya gafe bɛ wele ko (OHADA). O wajibiyalan bɛ sɛnɛkɛlaw kan. Sɛnɛkɛ ton bɛ ka kan ka a ka sariyaw sigi, ka lajew bɔlɔ da o ye wajibiye ton bɛɛ kan.

B. INTSORMIL/Mali Information and Communications Technololgy (ICT) Needs Assessment

INTSORMIL Mali ICT Needs Assessment

by

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Introduction

The International Sorghum and Millet (INTSORMIL) Collaborative Research Support Program (CRSP) is funded by the United States Agency for International Development (USAID) with the purpose of supporting international sorghum and millet research in twenty countries including Mali in West Africa. Its goals are to improve nutrition and food security, and to increase the income of farmers who produce these two crops. It shares its research findings through a number of educational programs conducted in concert with its in-country partners. Given the nearly 100% adoption of mobile phone technology within Mali, INTSORMIL was interested in determining the potential uses for this technology to enhance its educational programming efforts.

INTSORMIL, with support from the United States Department of Agriculture's (USDA) National Institute for Food and Agriculture (NIFA) contracted with the U.S.-based eXtension to conduct a needs assessment in Mali. The assessment was conducted February 12-19, 2012. The goals of the assessment were:

- Assess needs and conditions focusing on agricultural applications in sorghum and millet production, and marketing and processing.[1]
- Identify potential Communities of Interest (CoI) and their needs.
- Assess how research information flows to producers and in what formats and languages.
- Identify appropriate subject matter experts to participate in a future sorghum and millet Community of Practice (CoP).
- Identify potential educational and technical partners (internet, mobile, digital content, and translation).
- Assess other tech-enabled working models with an emphasis on mobile, e.g., short messaging system (SMS).
- Develop an action plan for pilot testing new Information and Communication Technology (ICT)-based strategies for use by INTSORMIL prior to September 2012.

Individuals from the following Malian agencies and organizations were interviewed as a part of the assessment:

- Association des Organisations Professionnelles Paysannes (AOPP)

- Association Malienne d'Eveil au Development (AMEDD)
- Assemblée Permanente des Chambres d'Agriculture du Mali (APCAM)
- Direction Nationale de l'Agriculture (DNA)
- Institute d'Economie Rurale (IER)
- Orange Mali
- Sasaka Africa Association
- The Cooperative for Cotton and Cereal Production in Kaniko (Sakasso region)
- United States Agency for International Development (USAID)
- Yereta-Ton farmers cooperative in Tingoni (Segou region)

Observations

The capabilities, opportunities, and challenges were assessed in four primary areas.

Communities of Interest (CoI)

The primary communities of interest identified through this assessment were the farmer organizations active in the 143 villages identified in the USAID Feed the Future Initiative. The USAID mission staff cited the need to scale educational efforts and to reach people more quickly as a high priority. Targeting the farmer organizations directly without a total reliance on information intermediaries; e.g., DNA and Non-Governmental Organizations (NGO) has the greatest potential for educational interventions. Issues identified by multiple interviewees as to using mobile phone technologies to reach farmers directly included:

- Low literacy rates
- The costs of mobile telephone services
- The lack of the availability of educational materials, especially in native languages
- The lack of educational materials in digital formats
- The lack of electricity
- The lack of cellular phone network coverage in all areas

The greatest educational needs of the people interviewed in the villages were not in agricultural production areas. Those interviewed were well aware of new technologies to increase yields (varietal selection, seed stock refreshing, crop rotation, soil fertility, pest management), and for mitigating post-harvest loss. They were also aware of the benefits of storage, and strategies for maximizing prices. The list of practices they cited were completely congruent with the recommended practices identified by the research, NGO, and extension people interviewed. NGO efforts, coupled with the work of DNA, and IER appeared to be quite effective. When asked where they turned for assistance with new technologies they identified their primary NGOs, DNA, and the research of IER. Their preferred methods of learning were demonstration plots.

The greatest educational needs identified were not concerning production technologies, but centered around the development of business and leadership skills:

- Access to and using credit
- Business practices (budgeting, planning, marketing)
- Cooperative governance
- Communication skills

The farmers did not use their cell phones to receive production or marketing information. Their phones were used strictly for voice communication. No one interviewed used the SMS capabilities of their phone. On more than one

occasion they mentioned the practice of flashing, calling someone and hanging-up before the call was answered. This is a strategy used to notify another person to call them back. In Mali, the person who originates a phone call incurs the costs of that call.

When asked how they received time sensitive farming information, in every instance, they mentioned their local rural radio station. In one instance, they talked about their chief listening to radio every waking hour. Others talked about always having their radios with them while working in the fields.

It is important to note that only two villages were visited as a part of this assessment. These were most likely exemplary situations, and not necessarily representative of the majority of villages. Assuming they were among the more progressive and better served villages, the ability to use mobile phone technology and other advanced ICTs would be even less effective as an educational strategy for more remote villages.

Communities of Practice

The most logical future Community of Practices identified would consist of people from those organizations currently working with the farmer organizations. These would include: NGO staff members, extension agents, IER scientists, other scientists, e.g., U.S.-based faculty, and private sector advisers, e.g., Compagnie malienne pour le développement du textile (CMDT), bankers, et al.[2] These entities are working collaboratively at the local level, and are already functioning much like a CoP with shared mutual interests and goals. It would make sense to further expand local educational efforts to include additional individuals in the areas where farmers have identified their greatest needs; business and communication skills.

There is little coordination between the various educational efforts at the village level. Different NGOs are active in each region, and as with any collaboration success is completely dependent on the strength of the relationships forged at the local level. If there is a lead entity in local programming it is the NGOs. Where the NGOs observed worked with both DNA and IER, they were also for the most part autonomous entities. The NGOs primarily used their own educational materials. There were no mechanisms to facilitate the sharing of educational content between NGOs, DNA, IER, and others.

There were almost no educational materials available in native languages. Where they did exist they were created by the NGOs. IER at the national level had only produced two educational documents in Bambara, and the inventories for both of these documents were exhausted. DNA staff were visited in the Sikasso and in Segou regions. The primary educational method being used by DNA was demonstration plots. While this was an effective teaching method in the villages with the plots, it was not an effective method for reaching villages at greater distances. Subsequently, this teaching method does not scale sufficiently to reach a large number of farmers.

No educational materials for farmers was observed in formats other than print.[3] At none of the organizations visited were there systems for organizing content in digital formats. There were no established digital standards. There were no archives of electronic documents. There were no mechanisms for creating derivative educational products. There were no mechanisms for providing translation services to vernacular languages. There was little in the way of information technology infrastructure other than access to broadband networks and computers in the offices. There were no collaborative work systems.

Steps necessary to create an effective Community of Practice:

- Funding will be required for staffing, meetings, infrastructure, and the production of educational materials.
- Someone needs to be responsible. Functioning CoPs at the local level were observed (NGO, DNA, IER), but no means existed to organize these local collaborations into an effective regional, national, or international effort.
- A technical infrastructure needs to be established to organize CoPs across distance. In order to foster collaboration, a framework for communication, coordination, and governance is needed. This system has to be

easy to use and supportive of appropriate languages; French for the CoP, and native languages (Bambara, Senufo, Soninke, et al.[4]) for educational material production.

- Intellectual property rights (copyright specifically) between the various CoP entities need to be negotiated, formalized, and monitored.[5]

ICT Delivery Infrastructure

Mobile phones

Virtually all of the people interviewed in this assessment had standard feature phones with access to 2G networks. These phones only supported voice communications and SMS texting. There were no smartphones observed, and in no location other than the largest cities were the networks capable of supporting smartphones with 3G capabilities (Bamako, Koutiala, and Sekasso).

While the cost of using phones is a deterrent to their use, phones would be an effective method for the delivery of targeted pre-recorded audio messages. These messages would have to be automatically delivered based on predetermined conditions (subscriptions), and not requested on a per message basis. The representative from Orange Mali indicated that this service is being developed, but has failed to follow-up on the particulars and cost. There are also indications that others have an interest in creating such systems and opportunities exist for partnering.[6]

The cost of text messaging (SMS) is a deterrent to its use. There are no short code service capabilities available in Mali. Current systems require the entering of a long international code, and are more complicated for people to use. This complexity, coupled with the higher cost to use an international gateway make SMS a poor choice for reaching the CoI at this time.[7] Several people interviewed mentioned that the cost to use these systems for the intended audience were just too expensive. The cost is a barrier to the people needing the information, and they are also too expensive for the entities originating the messages.

Using SMS systems to collect market information has proven to be effective. The Observatoire du Marché Agricole *(*OMA) uses a texting system to collect grain market information. The Global Livestock CRSP has developed a similar system for the aggregation of livestock market information. These systems are less effective for distributing market information to farmers, however. The small number of SMS texts sent to these systems bears this out. Given the constraints of cost and literacy, these systems will not scale to reach a sufficient number of farmers as an information delivery technology. In addition, the absence of a short-code support in Mali makes them too complicated and difficult for farmers to use.

World Wide Web

Dedicated connections to the World Wide Web were available in every city, and all of the NGO, DNA, and IER staff observed had computers (notebooks) connected to local area networks (LANs) in their offices. These LANs were in turn connected to the Internet providing email and World Wide Web services.

There was no access to collaborative work tools on any of these systems. For example, there were no organizational email accounts. Every person observed used an external email service.[8] Where each organization had a Web presence, these were for sites consisting of static content that the staff could not access other than as consumers of information. For example, the IER communications staff did not have access to their own Web site for the posting of educational content.

The access to technical staff with Web ICT skills appeared to be very limited. A cursory look at the in-country organizational Web sites showed sites developed with rather basic Web skills, and an ability to serve little more than static Web content.

There were no open and neutral Web sites for the collaborative development and sharing of educational resources between CoP members. Their current Web sites were inadequate for this purpose, and there would be cost, network infrastructure, and technical staffing constraints to establishing such a system.

Finally, the country's internet infrastructure constrains more advanced uses. The 3G network is often congested and unavailable. Even where dedicated Internet services were available the network performed poorly. The ability to serve video and other higher-bandwidth content was limited. One particular constraint is the capacity of the network trunks serving the country. Mali being land-locked, it is dependent on network connections coming through neighboring countries. In conversations with Orange Mali it appears that this situation is being rapidly addressed. Until these are improved some of the ability to do higher bandwidth educational programming will remain an issue, e.g., webinars originating from either within or from outside of Mali.

E-readers

Distributing content on e-readers to villages, e.g., Kindles or Nooks, has the potential to deliver both multimedia (audio) and text-based documents to the CoI, by-passing the limitations of no network access, and/or the cost of using the existing mobile network. Additional advantages of the e-paper-based models are the relative low power requirement and lower cost. These devices can operate for up to 10 days on a single charge. There are examples of this technology being used with success in other African countries (Worldreader). This might also be a low cost method to provide books and other educational materials to the schools in the villages.

The disadvantages to this method are 1) The cost of the devices (Approximately $100 retail); 2) The menus of the core devices would not be in native languages; 3) The devices require access to a power source for charging (but no worse than currently happening with cell phones); 4) The devices are a one-to-one medium. Where the devices could be shared they don't scale to meet the needs of large audiences easily; 5) Keeping the content current, and loading new content onto the devices becomes problematic as the devices are distributed to areas without networks; 6) With the devices being disconnected from a network it limits their use to static information-- they aren't well suited for conveying current and timely information; e.g., weather, market prices, pest alerts, etc.

Radio

Rural radio in Mali has the advantage of being free to the CoI, and with over 300 radio stations serving local audiences in native languages it reaches nearly everyone. Radios are inexpensive and can be used for a long period of time on a single set of batteries. They are a mass media device, one to many, and have the added advantage of reaching CoIs directly without going through an intermediary. The information can be timely and current, and if spoken in native languages negates the issues of literacy inherent in other forms of ICTs.

The disadvantages to radio are the cost and complexity of developing and distributing audio content, and managing relationships with a large number of radio stations. There are also many issues with translation and production in multiple languages. If the content was more in-depth, or in different formats, e.g., interviews or panels, then studios would be necessary for obtaining high quality recordings. Computer systems would be needed for audio mixing, editing, packaging, storage, and distribution. There are also issues concerning the copyright of the audio content produced.

Recommendations

Community of Interest

The target CoI should be members of the farmer organizations active in the 143 villages targeted by the USAID Feed the Future Initiative. Pilot efforts should be targeted at villages speaking Bambara. The initial recommended strategy should

be the delivery of educational materials in audio formats to mitigate the issues of low literacy rates and SMS texting costs. As a pilot effort materials should be produced in Bambara and then scaled to include additional native languages.

Communities of Practice

The initial CoP should be focused on people in the organizations already working in the targeted villages; NGO personnel, DNA staff, and IER scientists. A team needs to be identified and tasked with organizing the CoP effort as their primary responsibility. The initial efforts of the CoP need to be focused on the development of educational materials in native languages. Currently, even if appropriate ICTs were to be identified for reaching the farmers in the villages there is no learner-appropriate content to be delivered. The first and highest priority needs to be the development of a system for the collaborative creation of educational materials. At the national level, organizing the sorghum and millet CoP needs to be coordinated through AOPP, APCAM, DNA, IER, and the various NGOs.

An organizing effort needs to be started, governance determined, and intellectual property rights agreed upon. A neutral and open copyright like that offered through Creative Commons should be agreed upon from the start. A potential partner is OER Africa through their AgShare project.

Information and Communication Technologies

ICTs without appropriate educational content for delivery are of little value. The first priority needs to be developing the capacity to produce audio-based educational materials.

Phase 1: The first and highest priority is to create the capacity to produce audio educational materials in native languages. These capabilities need to be either created or acquired through partnership. A potential partner for assistance is Mali national radio (Office de Radiodiffusion Télévision Malienne).

Phase 2: Create a system for the distribution of dynamic and timely information to radio stations. Establish a budget for the regular airing of audio materials in various formats: announcements, interviews, panel discussions, etc. Mailing list capabilities for reaching the various demographics will need to be established. A potential partner for this effort is Farm Radio International which has nine representatives working in Mali.

A neutral Web-based collaborative work system needs to be established to support the creation of a CoP. This system could also be used for the archival and distribution of audio recordings, scripts (in both French and native languages), as well as other educational materials. Where this system won't serve the CoI directly, it will serve their needs indirectly through strengthening the efforts of the CoP. To scale this to an appropriate level will require dedicated administrative, educational, and technical support.

Phase 3: Explore distributing the audio and other graphic-based educational materials directly to the villages using non-networked technologies such as e-readers. A potential partner for e-reader technology is Worldreader (USAID is already a partner).

Phase 4: Establish a system for the distribution of shorter audio messages via a bulk phone voice broadcasting systems, or potentially SMS to speech technologies.[9]

End Notes

[1] Other than a brief visit with IER researcher Yara Koreissi at the IER Laboratory of Food Technology no assessment of agricultural products or marketing was conducted as a part of this assessment. Needs identified of processors were business skills.

[2] It should be noted that some distrust of private sector entities was detected especially of bankers, and CMDT. There could be a good argument made for creating an initial CoP that consists of only trusted members; e.g., NGO staff, DNA agents, and IER scientists.

[3] The INTSORMIL videos on YouTube are noted. Those videos do indicate that IER has the capacity and skill to develop educational content in formats other than print.

[4] The USAID staff mentioned the need to be able to produce materials in four languages in order to reach the Feed the Future villages (they did not mention which languages those were, and the languages spoken in the villages were not identified in the commune spreadsheet they shared).

[5] The question of sharing materials was raised in every interview with potential CoP members. Concerns over the "ownership" of their materials was evident. Relinquishing ownership of intellectual property to an eventual CoP will be an issue. This may be less of an issue for new materials developed as part of a collaborative effort, but the CoP will also need to deal with issues of copyright.

[6] OMA and the Livestock Marketing team from Texas A&M have expressed an interest in pursuing this type of solution. The costs of SMS and low literacy are driving voice as a possible solution.

[7] Standard SMS texts sent within the same carrier are $.05. In country, but sent to a different carrier (Orange Mali to MaliTel or visa versa) costs $.06. An international SMS is $.10. An SMS sent to an international gateway requesting a message back would cost $.20 round trip.)

[8] They were all using the France Yahoo Mail service. Their emails were provided by fr.mail.yahoo.com/

[9] Where this could be done there are some significant barriers for this to be practical. Maybe there will be cuts in costs, and the development of short-messaging capabilities to make this more practical as a future option.

Glossary

2G network - 2nd generation mobile phone network that supports voice communications and limited data capabilities; e.g., SMS texting, and basic photography.

3G network - 3rd generation network capable of transport speeds fast enough to support applications, email, and World Wide Web browsing.

Feature Phone - Older phone with physical keyboard primarily supporting only voice and SMS texting.

Long Number - a system where a person enters a long number code via SMS texting and receives back a specific piece of information via SMS on their phone. This is a system supported internationally, and is used in countries not supporting short code message systems. These systems are more expensive to the user than in-country short code systems.

Short code messaging - systems that allow a person to enter an abbreviated number and a keyword (for example: *54321 weather)* and to request that a specific piece of information be sent back via an SMS text.

Short Message Service (SMS) - a text-based messaging system for mobile phones. Often used for peer-to-peer communication, but systems exist for delivery to be from servers to phones.

Smartphone - phones with graphical user interfaces capable of running applications, browsers, GPS, and the World Wide Web.

Appendix

Interview questions asked in villages

1. Please tell me about your village, the crops you farm, and your farmer organization (history, members, etc.)
2. Outside of drought what are your biggest agricultural issues?
3. From who and where do you get your production information?
4. What technologies are you using to get your farm and market information?
5. What barriers do you face to the greater use of information technologies (phones)?
6. What production practices have you adopted? (Determine how these correspond with the research and technological advice being recommended to them by IER, DNA, their NGO, and private sector entities.)
7. What technological changes are you most likely to implement in the next growing season, and what are the barriers to your making these changes?
8. Who gets their farm production information from you, and how is that information transferred?
9. What things for the betterment of your village, farmer's organization, and farms are you most wanting to learn about?

Questions asked of information providers

1. Please tell me about your organization, its mission, its history, who you serve, how you serve them, where you work?
2. What are the most important products or services you provide to farmers?
3. Describe for me your information technology capabilities?
4. Can you show me the educational products you produce?
   Follow on questions concerned formats, languages, digital archives, distributions systems, etc.
5. What support is available to you: translation services, information technology, Web sites, network, computing?
6. Who do you primarily partner with to accomplish your objectives?
7. How willing are you to share your educational materials with other organizations? Could I take this publication of yours (for example) and translate it, modify it, and create something completely new and different? Would that be okay with your organization? If not, who would I need to talk to to get permission to do this?

C. Success Stories

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SUCCESS STORY

Malian Thick Sorghum and Millet Porridges Decrease Hunger

Photo by B. Hamaker

Very thick sorghum and millet porridge delays the feeling of hunger

Malians often experience hunger at the end of the dry season when most of the sorghum and millet grain from the previous crop has already been consumed. A study was recently conducted by the INTSORMIL/IER Project to examine thick sorghum/millet porridge consumption related to preference and satiation (lack of a hungry feeling) in the Sikasso, Segou and Mopti regions of Mali. This was part of a larger study to understand the effect of thick porridges, and delayed glucose delivery to the body, on satiety and overall food consumption. The satiety study was designed so that participants consumed as much tô as they wanted until they felt "full". Participants were asked at 2 and 4 hours after consumption to judge their feeling of hunger (0=full, 1=slightly hungry, 2=hungry, 3=very hungry). Very thick tô, thick tô, medium tô and thin rice porridge were compared.

The thick porridges were very satiating (hunger satisfying). Satiety study participants revealed large differences in their feeling of hunger 2 and 4 hours after consumption of the porridges of different thicknesses. Notably, participants still felt full 2 hours after eating very thick and thick tô, and after 4 hours only felt slightly hungry. After consuming the control rice porridge, at 4 hours participants felt very hungry.

Villagers eat thicker tô than city dwellers, perhaps related to its satiating effect and extended energy property. Urban populations should be encouraged to consume more sorghum/millet tô by conducting a nationwide publicity campaign with the slogan "*eat sorghum and millet – they are healthy satiating foods (not 'poor' foods)*". This is particularly important at this time of high prices for grain imports. If one million families ate only one more meal of sorghum/millet tô each week (using about 1 kg of flour for the meal), this amounts to about 50,000 metric tonnes of grain a year, which is more than the total wheat imports into Mali in 2008.

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RESEARCH BRIEF

Rooting Depth and Architecture are Critical for Productivity of Décrue Sorghum

Receding lake water in northern Mali.

Mr. Wahab Toure, IER Agronomist interacting with extension agents and décrue farmers in northern Mali.

Mr. Toure at experimental set up at at Kansas State University. Photos (R) shows profuse rooting of local genotypes Saba tienda and Saba soto compared to Niatichama.

Most of the sorghum in Mali is grown under rainfed conditions on the plains, but some is grown in the banks of rivers and lakes when the water level recedes (sorgho de décrue or décrue sorghum). This is one of the oldest and most fascinating methods of cultivating sorghum. The décrue production system is particularly practiced around water bodies in the Mopti, Gao, Tombouctou and Kayes regions. This production system plays an important role in the food security of these regions. As the floodwater recedes, seeds are sown in muddy soil and the crop is grown on the stored soil moisture. Depending upon the season, water from lakes and rivers spreads and recedes slowly. The decrue system is vulnerable to changes in the amount of water and the dry period following the recession of water. Thus, there is a large variability in amount and depth of soil water. This presents a unique challenge for selection of appropriate sorghum genotypes that can extract water from the deep profile and use soil water more efficiently. Not all genotypes are productive in decrue systems. Little is known about genotypic performance under these production systems. For improving yield of décrue sorghum, it is important to identify traits that contribute to greater yield stability in the extended dry season.

Thus, a research project funded through the USAID Mali Mission was initiated with a team of researchers led by Mr. Abdoul Wahab Toure from IER and Dr. Vara Prasad from Kansas State University (KSU) to collect and test the performance of local and improved sorghum genotypes under décrue production systems in northern Mali. It was observed that certain local genotypes (e.g. Saba soto and Saba tienda) had more stable yield in both good and dry years. The improved genotype Niatichama performed on par with local genotypes in a good year, but failed in a dry year. This was a very intriguing observation so we continued research to identify the reasons for this response.

Mr. Wahab Toure visited KSU and worked with Dr. Vara Prasad to understand the growth of décrue genotypes. Our aim was to identify traits unique for décrue sorghum. Research was conducted in controlled environment facilities. Four sorghum genotypes (two genotypes Saba soto and Saba tienda from the décrue region, one improved genotype Niatichama from the plains) were exposed to two moisture treatments: fully irrigated (no stress), and drought stress. Above and below ground growth was quantified.
Results from this research indicated that local genotypes Saba soto and Saba tienda had deeper rooting systems under both normal and drought conditions, when compared to Niatichama. In addition, Saba soto and Saba tienda had more number of fine roots distributed across the entire rooting depth. These traits could help extract water from deeper and wider soil profile and help produce high biomass and yield in the dry season. Research is currently underway to evaluate more genotypes and build a breeding program to develop suitable genotypes for the décrue production system.

For more details contact: Mr. Abdoul Wahab Toure (e-mail: abdoulwahab.toure@yahoo.fr) or Dr. Vara Prasad (e-mail: vara@ksu.edu).

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