



Intensive Production of Millet and Sorghum for Evolving Markets in the Sahel

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**Funded by USAID through the Sorghum, Millet and Other Grains Collaborative Research
Support Program (INTSORMIL CRSP)**

Leader with Associates Cooperative Agreement No. EEP-A-00-06-0016-00

July 16, 2012

One principal constraint to improving the performance of millet and sorghum systems is overcoming the conventional wisdom. The conventional wisdom has some or all of these characteristics depending upon where you hear it. "Sorghum and millet are subsistence crops." "They do not respond to fertilization." "Even if they do respond to fertilizer, it is not profitable." "Farmers will not use fertilization on these crops even if there were agronomic and economic responses." "Banks will not lend to farmers for sorghum and millet fertilization."

From Pilot Project to Scaling Up

With a pilot project we wanted to disprove these assertions and create a model for a widespread scaling up process. We started our activities in 2003 with the concept that a series of changes would need to be incorporated into the farmers' production systems to enable overcoming the initial adverse element of very low soil nutrients. There are new technologies available for these crops as there has been substantial research investment in sorghum and millet in the Sahel since the great televised drought of 1968-1973. Technology development focused on new cultivars but there were a series of other associated technologies including fertilization research. *Our concern and that of national governments and donors was that so little of these new technology developments were getting out of the station and onto farmers' fields.*

So how to explain this transfer failure? The emphasis on low input solutions certainly is a culprit. It makes no sense to look for a low input solution to increasing cereal yields when the basic nutrients are deficient.¹ That is similar to telling poor, malnourished people they have to eat less. Farmers are poor and often access to credit is difficult. But let's look at the problem from the opposite direction. We have to provide sufficient soil nutrient for plants to grow even for the new cultivars. So how do we pay for the increased expenditures for moderate fertilization and improved cultivars? Rather than focus on low inputs to reduce costs and thereby neglect the essential role of the basic plant nutrients in increasing yields, we focus on improved marketing strategies and new institutions to raise the prices of products received and reduce the costs of inputs. So the focus is on increasing revenue rather than reducing input use.

The marketing strategy is the key to technology diffusion but innovations in extension and credit are also necessary. The second hypothesis concerns extension methods. It is that few farmers respond to demonstration trials. They believe that they cannot reproduce these results because they cannot get access to the inputs or pay for them or they cannot handle the increased management requirements of

¹ Much intellectual energy has been spent on the low input search over the past two to three decades in the Sahel. Generally this reduction in input use is substituted for with sophisticated management practices such as rotation and N fixation for the legume in a cereal-legume system. These low input recommendations fail to appreciate the complexity of their recommended practices as starter N and micro nutrients are often required for successful N fixation. Moreover, the burden of proof is now on the low input promoters after more than two decades of failure. There have been some successes in encouraging improved manure use with increased compost heaps in many regions of the Sahel especially in Burkina Faso. Also in Burkina Faso a series of water retention devices have been introduced. All of these practiced have then been imitated in other Sahelian countries.

low input strategies. *Farmers react to what other farmers in their region do rather than to outside demonstrators or advisers so a village level approach to extension is necessary.*

Finally, with respect to credit. Banks look for either collateral and/or personal knowledge of borrowers to reduce default risk. Since small farmers generally don't have land ownership for collateral in West Africa or know bankers, new institutions are necessary to make these connections. These new institutions, farmers' associations, handle default risk as is done in micro-credit. All must reimburse or there is no future credit so there are substantial group pressures to reimburse. Moreover, there is group pressure to only include those members most likely to reimburse.

Development of a Marketing Strategy

In developing a marketing strategy let's first look at how millet and sorghum prices perform seasonally and between years. Figures 1 and 2 below show the normalized prices by month over the six year period, 2003-2009. All prices are put at the base of 100 to illustrate the percentage changes. Note the collapse of the millet and sorghum prices in November-December. Note also that in poor rainfall years price increases of 50 to 100% are observed in the "sodure" or hungry period in the fall before the next harvest. These price increases in adverse rainfall years are especially important because in these years even though farmers with moderate fertilization out yield farmers with traditional practices, they still need some help on the revenue side.

There are five ways employed here to improve the product prices of sorghum and millet: 1) First, if farmers have access to storage facilities they can avoid selling at the post harvest price collapse period; 2) secondly, we identify new markets beyond the first two stages of local or village buyer and regional town buyer. We are especially interested in millet food processors in the major cities and in broiler producers for sorghum; 3) The third alternative is to add value to the cereals. Millet processors in Bamako have reported an average of 13% impurities in the millet bought in urban markets (Toure et al, 2007, p. 14). For millet processors having access to clean cereals is especially important to protect their machines and to assure customer satisfaction. They are generally willing after a negotiation struggle to pay a price premium for higher quality of approximately 20 cfa/kg (exchange rate in summer of 2012 510 cfa/kg). Quality can be increased at the farm level by

Figure 1 (Source: Estimated by J. Coulibaly from data in the National Marketing Watch (OMA-Mali)

Millet Prices in Koutiala (regional trade center), Mali, 2003-2009

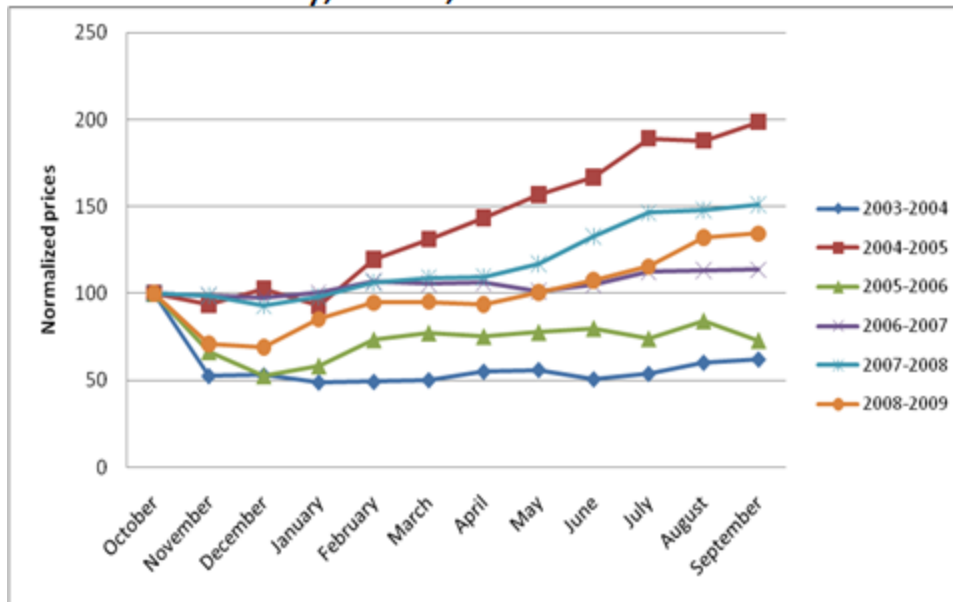
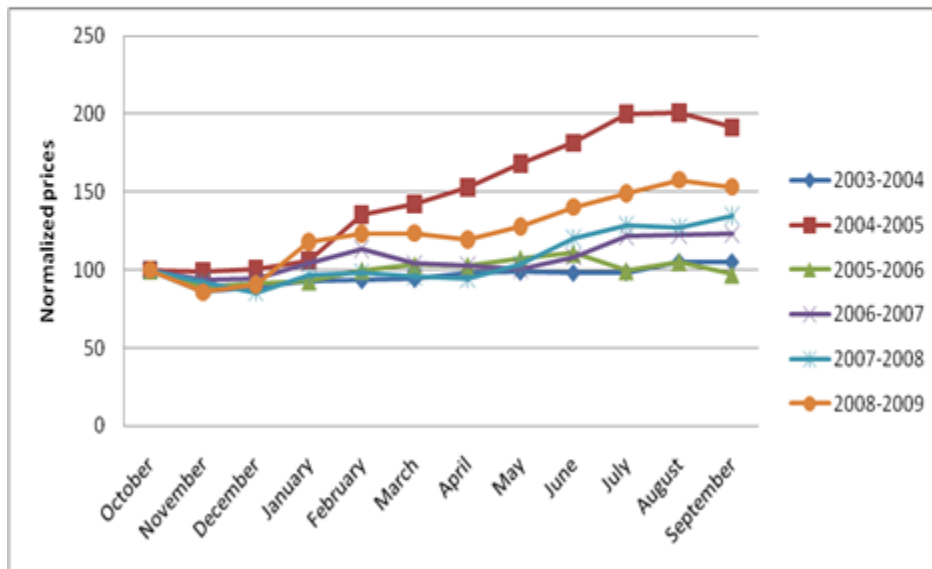


Figure 2 (Source: J. Coulibaly, 2011, p. 32.)

Sorghum prices in Koutiala, Mali: 2003-2009



not putting the heads on the ground at harvest and doing the threshing on plastic or canvas; 4) Fourth is the increased bargaining power. When farmers sell through farmers' associations, they can do all the functions of the large "commerçant." The farmers' associations then gather small quantities of cereals, store, do a price search for the best buyer and sell in quantity. It takes time for the farmers' associations to gain confidence of the members and to function as a marketing cooperative including the purchase of sufficient quantities of inputs to obtain price discounts; 5) Fifth, involves presentations and publications that are designed to help convince public officials that they should not intervene to reduce cereal prices except in the worst drought years.²

For our extension approach the basic concept is that farmers do not respond to demonstration trials. Demonstration trials are principally for the benefit of researchers. So we conduct village level extension looking for the participation of 50 farmers in a given village. Even with this village approach often only 20 to 30% of the farmers will diligently follow the recommendations. But in the second year of the project there will be an imitation of the successful farmers.

Our bank constraints are easily identified. Banks want collateral and to know the borrower. Banks have been willing to make loans to *established* farmers' associations that have bank accounts. To introduce banks from the start of the process we need a new institution to handle the default risk and to know the individual borrowers. The loans of all need to be repaid to make the associations qualified for a loan in the next year. The farmers' association needs to function like the small groups in micro-credit programs.

With micro-credit the borrowers screen the other borrowers for their repayment expectations. It has also been shown that micro-credit groups will allow a member with a suspected lower propensity to repay to be in the group if she makes an insurance deposit to the group (for a review of group pressures and group selection see Shahriar, 2012, p. 37). Handling default risk in a bigger group such as with 50 to 150 members is a larger challenge than with the five to ten members of micro-credit groups. But the micro-credit evolution illustrates this to be a successful model and meets the institutional requirements to respond to the bank's demands.

Small farmers want favorable interest rates and to be able to repay when the price has recovered from the harvest time price collapse. It was necessary to negotiate with the banks to get loans with longer repayment periods. When the final buyers make contracts with farmers' associations or put up some of the funds for input purchases, banks have been more willing to lend to first year farmers' associations. This was the model sought in 2011 and 2012 for the scaling up operation.

² This type of major drought occurs approximately once a decade. In contrast moderately adverse years include about 15%-25% of the time. See Vitale and Sanders, 2005, p. 120 where adverse years had a probability of 15%; in Tahirou and Sanders, 2006, p. 276 where 17% was used for adverse rainfall years; Baquedano et al., 2010, p. 421. Baquedano uses 24%. All three take out the approximate 10% for extreme drought years and then recalculate the probabilities. The assumption is that farmers expect outside relief in these extreme drought years and so farmers do not include them in their calculations of the optimum system for the expected weather conditions.

Conclusions

The integrated strategy focusing on marketing, a new extension method, and credit appears to be working well. Now average farm yields of 1.5 t/ha for sorghum and 1.2 t/ha of millet are obtained when farmers follow well the recommendations in good and normal rainfall years.³ Best sorghum farmers have gotten 2 to 3 tons/ha of sorghum and millet producers 1.8 to 2 t/ha. As we get sorghum yields up to 2 tons/ha on average we will be introducing sorghum hybrids to these village associations. These yields are a solid improvement from 800 kg/ha to one ton/ha for sorghum with traditional practices in the cotton zone. For millet traditional yields are lower at 400 to 700 kg/ha.

We have obtained 20 to 50% price increases with the implementation of the marketing strategies over the past five years. As we get better in training marketing and farmers' associations build stronger ties to their members, farmers will allow the associations to sell more of their products and this price advantage will be further increased. Note that this price increase is especially important in adverse rainfall years as the fertilizer-new cultivar response is much lower then. Our technology still out yields traditional farmer yields in these adverse years (again with farmers following well the recommendations) but these price increases are critical then to maintain profitability.

The objectives of the pilot project of refuting conventional wisdom and creating a model for the scaling up process have been achieved. In the decade we have been working on extending new technologies in the Sahel for these crops, we have shown that there are other buyers for millet and sorghum besides subsistence use and even local and regional markets; there is a good fertilizer response to moderate levels of inorganic fertilizer and it is highly profitable for farmers (Baquedano et al., 2010; Coulibaly, 2010; Coulibaly et al. forthcoming; Ibrahim, forthcoming). The marketing strategy is especially important in adverse rainfall years; banks are presently providing credit for sorghum and millet production in Mali and Senegal.⁴

Moving from a pilot product to scaling up in both Senegal and Mali is an important step. This scaling up reached 2,000 ha in Senegal and 5,000 ha in Mali in 2011. However, there were 1.4 million ha of millet in Mali and 746 thousand ha in sorghum in 2004-2007 (mean values in Broughton and Kelly, 2010, p. 2). So there is still a substantial scaling up process necessary to have aggregate effects on yields

³ The basic technology package is one sack of DAP, one sack of Urea, and an improved cultivar treated with fungicide. Water retention practices are recommended as is manure. Farmers are trained in the labor intensive agronomic practices. The agronomic and marketing concepts are available in cookbook form ("fiche technique") in both Bambara and Dogon (French versions for sorghum and millet in the references). They will be translated now into Mossi and Hausa. Note that when DAP is not available, we have been forced to substitute for one sack of DAP with two sacks of NPK. So this indicates the need for the evolution of the fertilizer markets in the Sahel as the two sacks of NPK is more expensive and not more effective in increasing yields.

⁴ Banks lent to famers in both countries in 2011 and to Senegal in 2012. With the disruptions in Mali (coup d'etat and civil war) during 2012 we will need to confirm what is happening there in 2012 with respect to bank lending. There were an estimated 5,000 ha in Mali and perhaps 2,000 ha in Senegal in 2011. This is direct involvement of NGOs following program specifications close to our original pilot program. This is not the usual guesstimate of farmers' possibly using some new technology. These NGOs can give farmers' names, areas and quantity of loans.

and prices. Organizationally we now need to more systematically include banks and final buyers in the scaling up process.

We have selected the best sites and farmers we could find. Hence, it is important not to exaggerate the potential for all farmers to follow these practices. Clearly many farmers will not be interested and not all farmers' associations will perform well. However, even adopting parts⁵ of the program is expected to have a substantial effect on other farmers producing principally for their own subsistence. Moreover, these crops are critical food crops in West Africa and a more widespread adoption of these technologies will lead to cost reductions per output unit and thereby enable food prices to fall while still encouraging farmers to adopt them.⁶

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⁵ Adopting the cultivar without the inorganic fertilizer has been unsuccessful when tried in Niger and we expect this particular modification to fail wherever the soil nutrient deficiencies are critical.

⁶ Ultimately, price declines will eliminate the cost savings of late adopters. But we are a long way from this point in the Sahel. This phenomenon leads to farmers needing to run faster to keep reducing costs while the demand conditions of non-export crops pressure them with falling product prices over time. This treadmill effect of new technologies is one of the reasons developed countries provide various types of income and price support to farmers.

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