The Economic Impact of New Sorghum and Millet Technology Adoption in Niger: Performance and Challenges

2010-2011 Cropping Year

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July 2012

Bulletin N₀12

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Front cover pictures are the courtesy of Dr. Botorou Ouendeba. Right picture: picture of Sepon 82 at maturity in the valley of Angoua Mata (September 2010). Left picture: dried millet stalks being transported to storage for family food consumption in Tourba (October 2011).

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Introduction

In this report we present the results of the field research in Niger from interviewing producers in the summer of 2011 about the last three crop years 2008 to 2010. After working in Niger from 2005 to 2007, activities stopped in 2008 and were restarted in 2010. So, we are studying continuity in the absence of the project as well as project performance in 2010.

The objectives in this bulletin are to evaluate the economic impact of the Production-Marketing project of the International Sorghum and Millet (INTSORMIL) program in Niger and to appraise the performance of the project in achieving the goals of improving yields through better technologies and agricultural practices, of obtaining higher prices due to a product quality premium and to storage, and in boosting farmers' incomes from both yield and price increases.

The report describes the different agricultural practices, examines the diverse forms of resources that enter in the crop production system, identifies some challenges that producers are facing and discusses recommendations. An econometric analysis is also provided to evaluate farmer compliance with the agronomic recommendations and the impact upon observed yields.

Background

The Production-Marketing project with the collaboration of INRAN (the National Agricultural Research Institute of Niger) trained households through their village farmers' association to promote the introduction and the diffusion of new millet and sorghum technologies. The program provides input credits for improved cultivars of millet and sorghum to pay for moderate levels of inorganic fertilizers, improved seeds and fungicides. Moreover, the program trains involved producers on how and when to perform different cultural practices. After harvest, the participating farmers pay back in kind the input credits to the farmers' association. The reimbursement is then stored and sold before the next production season to pay for the inputs to be used the following crop season. It becomes an annual revolving fund for input purchases.

Farmers are also encouraged to contribute and sell additional grains through the association. The marketing component of the program is as important as the production component. The marketing component of the project targets the development of the association to bargain for higher prices for their products. Higher prices result from the quality premium for their products, the storage factor, and the increased bargaining power from selling larger quantities.

The farmers' association stores the grains for several months. Even before the next crop season market prices of staple foods are generally increasing after their post-harvest collapse. After the initial credit infusion in the first crop year, the farmers' association is then in charge of buying inputs (inorganic fertilizers) directly from local sellers or government agencies. This gives the association greater purchasing power for buying larger quantity of inputs as well as selling the products moving the farmers' association towards an independently functioning marketing coop.

Program composition and report organization

The project operates in two regions of Niger, Maradi and Tillabery. A total of 79 ha of Sepon 82 (the improved sorghum variety) and 49 ha of Zatib (the improved millet variety) were planted in 2010. In what follows are summarized the results of the field survey conducted in the summer of 2011.

This report is divided into two parts. The first part presents the field results of Sepon 82 (sorghum) in the region of Maradi for the 2008-2010 period. The second part discusses the field results of the Zatib (millet) in the two regions of Maradi and Tillabery for the 2010 cropping season.

The report includes: a yield analysis of the improved technology adoption, an analysis of factors that impact the yields of the improved varieties, a marketing analysis, an income effect, some econometric regressions to explain yield variations, and recommendations.

Part One: The Improved Sorghum Variety, Trend and Economic Performance

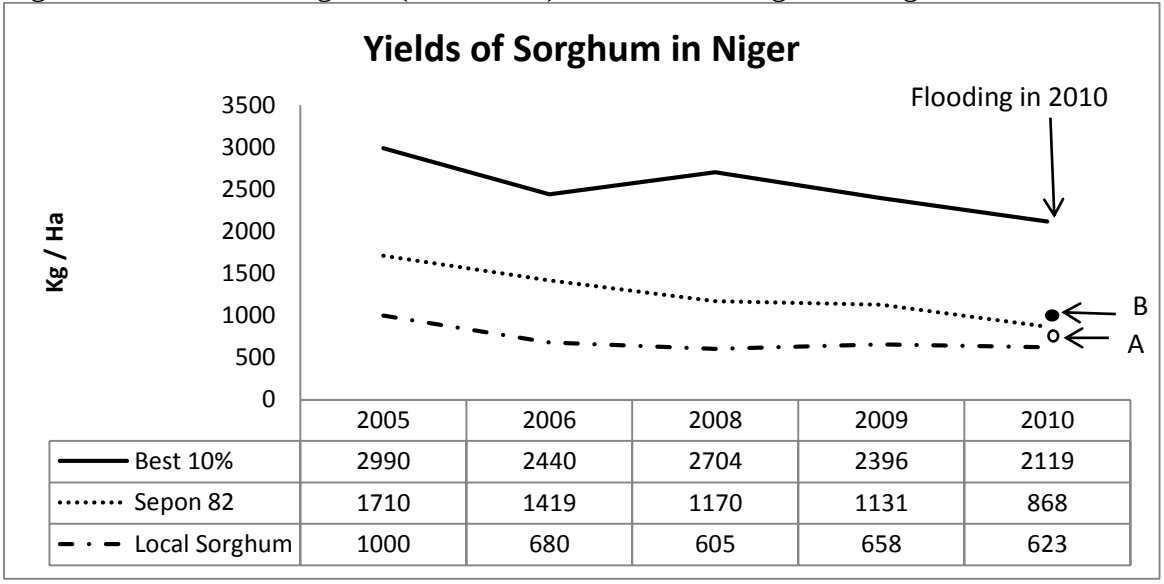
I. Sorghum in the Maradi region of Niger from 2005 to 2010

In the early years of the introduction of the Sepon 82 in the Maradi region, the program flourished. Producers were able to increase their sorghum yields considerably by cultivating Sepon 82. This gave a big impetus for the implementation of the project in the Maradi region by increasing the number of producers in the program. The average yields of Sepon 82 during the 2005-2009 period surpassed the traditional sorghum yield by at least 70% (figure 1.1). The best producers' (the ten percent highest) yields were at least double of local producers following the traditional practices (figure 1.1). The best producers followed well the recommendations and planted sorghum on good lands with manure.

Sorghum producers in this region have been part of the program for many years. Even though the INTSORMIL project was absent in Niger for two years (2008 and 2009 crop years) the revolving funds continued to operate from the earlier program so the producers were able to continue using these funds to purchase inputs. During these two years of absence, Sepon 82 yields were excellent and still substantially out yielded traditional or local cultivars (figure 1.1). Overtime producers with higher sorghum yields from Sepon 82 have concentrated this cultivar more in the valleys pushing the local sorghum more onto slopes and plateaus.

Unfortunately, being in the valley was not as advantageous in 2010 when flooding became a problem. With the flooding of 2010 the new cultivars were especially vulnerable due to their concentration on the lowlands. Also Sepon 82 as a Caudatum is more subject to the mold-head bug complex from late season rains than the traditional Guinea cultivars. With flooding and late season mold-insect damage Sepon 82 yields were only 868 kg/ha in 2010 crop year on the 79 ha cultivated there (figure 1.1).

Figure 1.1. Yields of sorghum (2005-2010) in the Maradi region of Niger.



	2005	2006	2008	2009	2010
Best 10%	2990	2440	2704	2396	2119
Sepon 82	1710	1419	1170	1131	868
Local Sorghum	1000	680	605	658	623

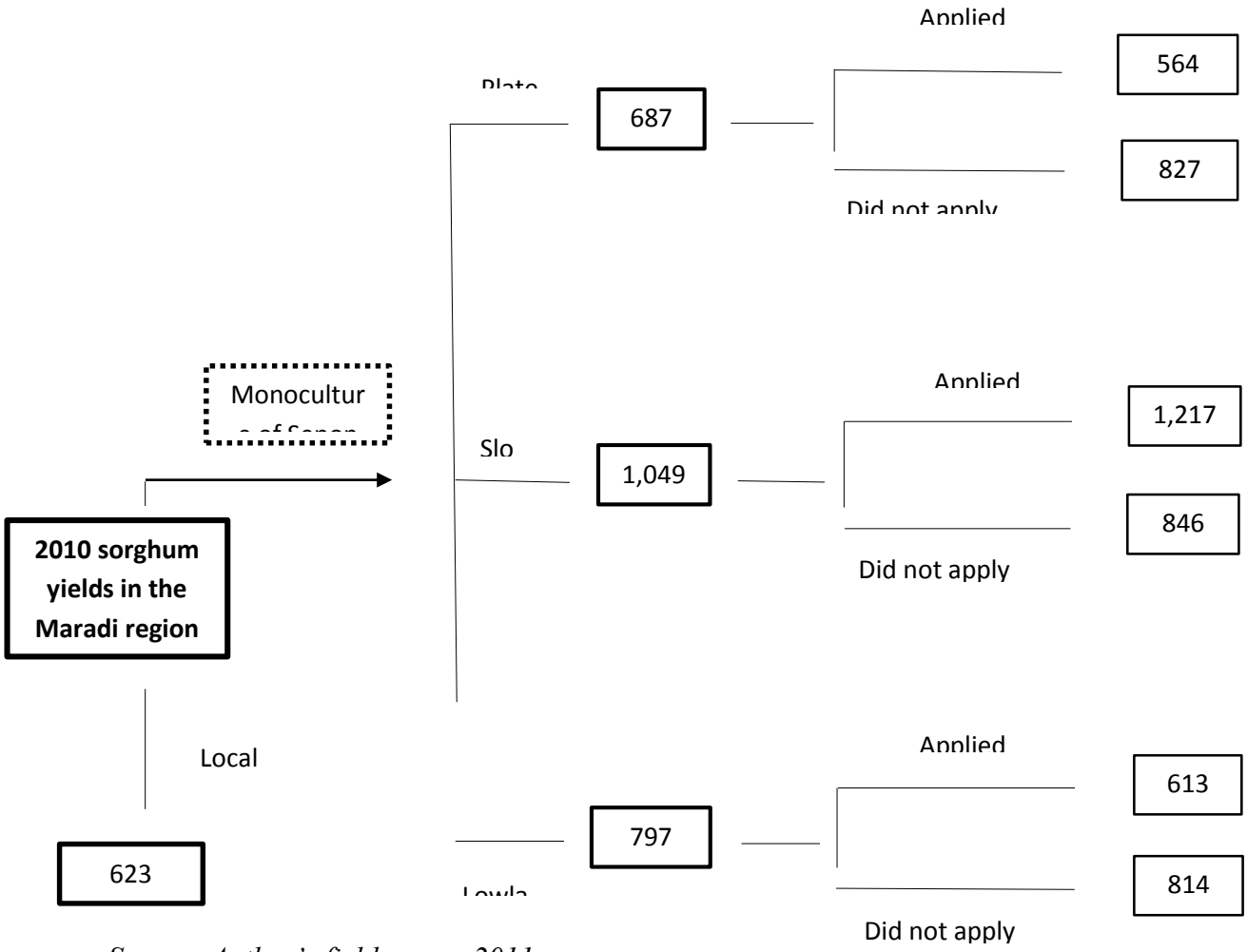
"A" represents the average yield of Sepon 82 planted on lowlands (797 kg/ha) by monoculture producers.
"B" represents the average yield of monoculture Sepon 82 (1,049 kg/ha) planted on slopes.
"Best 10%" represents the average Sepon 82 yield obtained by the highest ten percent Sepon 82 yields of the sample survey. The number of observations of the best 10% in 2005 and 2006 are respectively eight and six (Abdoulaye, Sanders, & Ouendeba, 2007; Abdoulaye, Sanders, & Ouendeba, 2008). The number of observations of the best 10% in 2008, 2009, and 2010 are respectively four, six and eight farmers (Author's field survey). This does not include the site of Angoua Mata. Farmers clearly did not follow the program in Angoua Mata in the last two years so we are not including these yields here. Note: After the regional project was finished in 2007, we were unable to finance the field study of yield results for that year. Recall data were taken during 2011 for 2008 and 2009. The 2005 and 2006 data were done approximately six to eight months after the harvest in both cases.
Source: Abdoulaye, Sanders, and Ouendeba (2007, 2008); Author's field survey 2011.

However, in 2010 on the slopes where there are positive effects from the high rainfall, there was a significant yield difference of 1,049 kg/ha (1,217 kg/ha with manure) as compared with 797 kg/ha on the lowlands (figure 1.2).

The sorghum on the slopes with manure doubled the local or traditional sorghum yields. Here manure raised yields by 371 kg/ha (figure 1.2).The lowest yields were on the most infertile soils, the plateaus. Here even the manure did not help. The lowlands with manure did not do much better than the plateaus in this bad flooding year. With the flooding the manure probably held even more the water and further reduced yields on the lowlands.

Even excluding the flood year 2010, the overall yield decline overtime indicates the need to renew the seed (see trend line for average yields in figure 1.1). In 2011 the program financed the production of renewed seed of Sepon 82.

Figure 1.2. Average monoculture sorghum yields (kg/ha) distribution in the Maradi region of Niger



Source: Author's field survey 2011.

1.1 The Site of Aouna Da Kanka

In 2007 the program stopped in Niger but farmers successfully continued activities we initiated with them in 2008 and 2009. In 2010, in addition to the 15 ha of input credits provided by the program, the farmers' association of Aouna increased by five additional hectares the area in Sepon 82. This expansion in area came from revenue earned by the farmers' association in 2009.

The sample survey is composed of 26 men operating on 16.5 ha of monoculture Sepon 82 (table 1.1.1).

Table 1.1.1. Total area planted, area and number of producers surveyed under monoculture of Sepon 82 in Aouna

	Total area planted (ha)	Area planted by monoculture producers in the survey (ha)	Number of monoculture producers in the survey
Sepon 82	20[a]	16.5[b]	26[c]

[a] The project made input credits for 15 ha. The association of Aouna financed five additional hectares so that more producers could benefit.
[b] The total area cultivated by producers in the survey is 19.75 ha including 16.5 ha for monoculture purpose and the remaining 3.25 ha with association.
[c] The number of producers interviewed is 33 of which 26 producers in monoculture and 7 in association with cowpeas.
Source: 2011 Farm Household surveys.

1.1.1 Sorghum Yields from 2008 to 2010 in Aouna Da Kanka

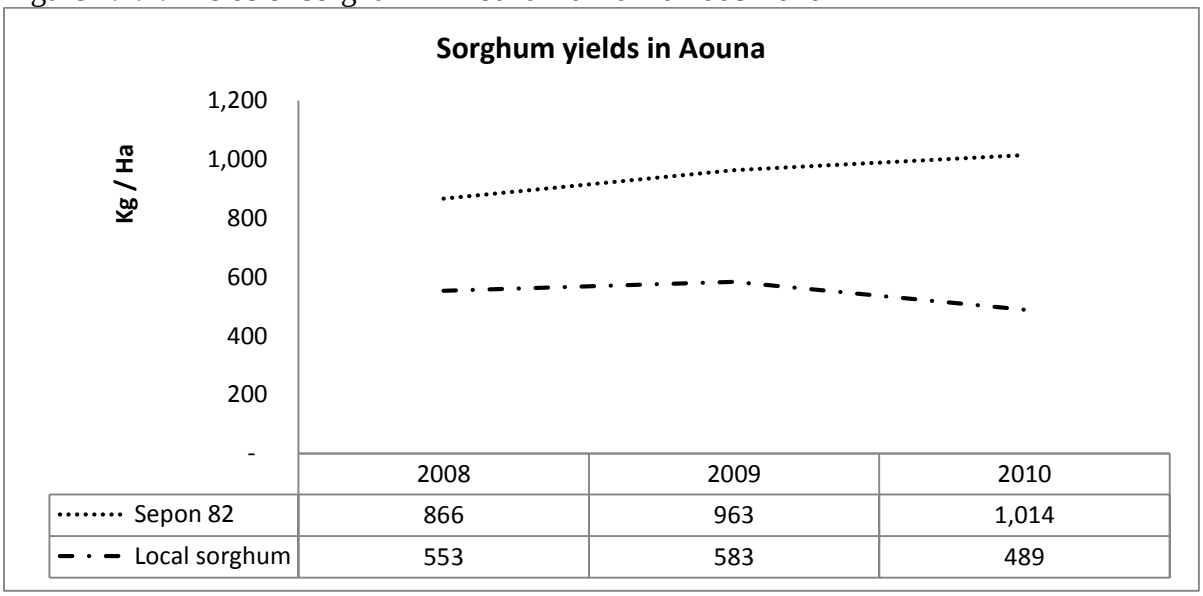
From 2008-2010 Sepon 82 yields increased slightly. Of all sites of Sepon 82 in the Maradi region of Niger, Aouna is the only village that did not have a yield decline with the flooding of 2010. Yields of producers in Aouna improved each year from 2008 to 2010. This is the normal pattern we would expect in the absence of flooding or drought. The Sepon 82 yield in 2010 more than doubled the traditional sorghum variety (table 1.1.2 and figure 1.1.1). The average yield reported by producers in Aouna is 1,014 kg/ha in 2010 which is 107% greater than the traditional or local sorghum yield.

Table 1.1.2. Average yields of sorghum reported by producers in the village of Aouna

Years	Crops	Number of Observations	Mean	Standard Deviation
2010	Sepon 82	26	1,014	424
	Traditional sorghum	17	489	224
2009	Sepon 82	21	963	533
	Traditional sorghum	11	583	331
2008	Sepon 82	13	866	493
	Traditional sorghum	5	553	169

Source: 2011 Farm Household surveys

Figure 1.1.1. Yields of sorghum in Aouna Da Kanka 2008-2010



Note: The number of observations for the improved sorghum is 13, 21, and 26 respectively in 2008, 2009 and 2010. The number of observations for the traditional sorghum is 5, 11, and 17 respectively in 2008, 2009 and 2010.
Source: 2011 Farm Household surveys

Yields on lowlands representing 54% of the area under Sepon 82 in Aouna were also reduced substantially to 861 kg/ha. However, yields were excellent on the slopes and one farmer on the plateau used substantial manure (27 carts) to get his yields up.

Table 1.1.3. Proportion of Sepon 82 planted on plateaus, slopes, and lowlands in Aouna

	Plateaus	Slopes	Lowlands
Yields	1,178	1,201	861
Number of farmers	5	7	14

Source: 2011 Farm Household surveys

1.1.2 Factors affecting the yields of Sepon 82 in 2010 in Aouna

Even though yields were lower on the lowlands the average yield decline from flooding was only 74 kg/ha. One third of the farmers complained about flooding.

Manure had a significant effect of 645 kg/ha but on the average that was for 31 carts with only a 21 kg/ha effect on sorghum per cart. Only 12% of farmers used manure in Aouna. We will return to this low return on manure in our econometric analysis.

Table 1.1.4. Factors that affected yields the most in Aouna Da Kanka

	Frequency		Average Sepon 82 yields (kg/ha)	
Factors	Yes	No	Yes	No
Flooding	31%	69%	963	1,037
Manure use	12%	88%	1,584[a]	939
InterCropping of Sepon 82 with cowpeas	21%	79%	1,583[b]	1,014[b]

[a] *On average for the farmers using the manure 31 carts of manure were applied per ha in addition to the inorganic fertilizer.*
[b] *The majority of monoculture producers (54%) planted on lowlands while in the other group lands were predominantly on the slopes (57%).*
Source: 2011 Farm Household surveys

1.1.3 Gains in yields from the adoption of monoculture Sepon 82 in Aouna

The difference in yields of monoculture farmers between their improved and their traditional sorghum varieties is 525 kg/ha (table 1.1.5) and this was used to calculate profitability.

Table 1.1.5. Yield gains from the adoption of the improved varieties of sorghum in 2010 in Aouna.

	Average Sepon 82 yield (kg/ha)	Average traditional sorghum yield (kg/ha)	Yield Difference (kg/ha)	Yield Effect (%)
Aouna	1,014[a]	489[b]	525	107%

[a] *The average yield reported by 26 producers following monoculture of Sepon 82.*
[b] *The average yield of traditional sorghum obtained by monoculture Sepon 82 farmers.*
Source: 2011 Farm Household surveys

1.1.4 Cost of the technological package in Aouna Da Kanka

The cost of the technological package of Sepon 82 in Aouna is 31,700 FCFA per hectare (table 1.1.6).

Table 1.1.6. Per hectare cost of the sorghum technological package in Aouna

Items	Quantity (… /ha)	Unit cost of the item (… /ha)	Total cost of the item (FCFA /ha)
Sepon 82 seeds	8 kg	400 FCFA/Kg	3,200
DAP	1 sack=50 Kg	14,000[a] FCFA/sack	14,000
Urea	1 sack=50 Kg	14,000[a] FCFA/sack	14,000
Fungicide	1 bag	500 FCFA/bag	500
Total			31,700

[a] *The cost of* inorganic *fertilizer (DAP or Urea) is 13,500 FCFA/sack. The village of Aouna being far from Maradi, it costs an additional 500 FCFA/sack of fertilizer for transportation cost.*
Source: 2011 Farm Household surveys

1.1.5 Reimbursement and Marketing Strategies in Aouna Da Kanka

The rate of reimbursement of the input credit was 100%. All producers repaid in kind 240 kg/ha (table 1.1.7). After paying the reimbursement the main use of their sorghum was for home consumption, 713 kg/ha (table 1.1.7). Small quantities were sold through the association and locally. The quantity sold through the association is an important indicator overtime of the farmers' support to their association.

Table 1.1.7. Averages of Sepon 82 reimbursed, sold and consumed by Aouna monoculture producers in kg/ha in 2010

Yield Sepon 82	Total reimbursement	Sold through the association	Total quantity in storage	Sold individually on local markets	Consumed
1,014	240	28[a]	268	33[b]	713

[a] *Three producers sold through the farmers' association 240 kg/ha on average but only 28 kg/ha when we consider the total sample (26 farmers).*
[b] *Two producers sold individually on local markets 433 kg/ha on average but only 33kg/ha when we consider the total sample (26 farmers).*
Source: 2011 Farm Household surveys

The harvest price of Sepon 82 was 12,000 FCFA/sack but producers reimbursed the input credit at 14,000 FCFA/sack[1]. The association first sold locally 23 sacks of Sepon 82 at 13,500

[1] This 14,000 FCFA/sack the association paid to farmers resulted from the collective decision of the membership to set a high implicit sale price for repaying input credits. This price was higher than the harvest price in the region at the time of reimbursement.

FCFA/sack and then through an intermediary INRAN agent (the National Institute of Niger Agronomic Research). This middle man sold 25 sacks for the association. Five sacks were sold at a price of 15,000 FCFA and the remaining twenty sacks at 16,000 FCFA. However, he reported to the association a price of 13,500 FCFA. Later this INRAN employee was forced to repay the association. With this restitution the average sale price becomes 14,700 FCFA/sack but it is still substantially lower than what farmers were able to get with individual sales, 21,000 FCFA/sack (table 1.1.8). This experience indicates the need of the association to invest more time of their officials and even money in their marketing activities.[2]

Table 1.1.8. Storage and Quality effects on product prices in Aouna

	Harvest price (FCFA/kg)	Sale price (FCFA/kg)	Price difference (FCFA/kg)	Price effect (%)
Farmers' association before restitution at original price	120	135	15	13%
Farmers' association after restitution at refunded price	120	147[a]	27	23%
Sold individually	120	210	90	75%

[a] Represents the weighted average price of five sacks sold at 15,000 FCFA, twenty sacks at 16,000 FCFA and twenty three sacks at 13,500 FCFA.
Note: The farmers' association sold their grains from members' reimbursements in June (second week). Individual sales were spread between January and March. So the advantage of individual selling was in finding a better market rather than selling later.
Source: 2011 Farm Household surveys

1.1.6 Profitability from the adoption of new sorghum technology in Aouna Da Kanka

We calculated profitability at both the original price reported by the middleman to the association and at the reimbursed price when he was pressured to return the money. At this reimbursed price the return to the Aouna association increases the income gains from the adoption of Sepon 82 from 143% to 171% (table 1.1.9). However, note that even with the poor marketing case, yields were sufficiently high to make the technology introduction very profitable. So, Aouna producers did very well even with the flooding and their marketing agent initially taking advantage of them.

Table 1.1.9. Per hectare gains from the adoption of monoculture Sepon 82 in Aouna in 2010

	Gains from increased yield[a] FCFA/ha	Gains from grains[b] sold FCFA/ha	Gains from consumption[c] FCFA/ha	Gains from individual sales[d] FCFA/ha	Gross revenue gains[e] FCFA/ha	Cost of technological package[f] FCFA/ha	Net gains[g] FCFA/ha	Returns on adoption[h]
Original price	63,000	420	10,695	2,970	77,085	31,700	45,385	143%

[2] The association had to lease the storage area so this cost will need to be added into future accounting.

Refunded price[i]	63,000	756	19,251	2,970	85,977	31,700	54,277	171%

[a] *Is obtained by multiplying the monoculture yield difference (table 1.1.5) by the harvest price (table 1.1.8).*
[b] *Is obtained by multiplying the amount of grains sold through the association by monoculture Sepon 82 producers in excess of their reimbursement (table 1.1.7) by the price difference (table 1.1.8).*
[c] *Is obtained by multiplying the average quantity of Sepon82 consumed by monoculture producers (table 1.1.7) by the price difference (table 1.1.8). We assumed producers sold these products through the farmers' association.*
[d] *Is obtained by multiplying the average quantity of Sepon82 sold individually on local markets by monoculture producers (table 1.1.7) by the corresponding price difference (table 1.1.8).*
[e] *Is obtained by summing the gains from increased yields, stored grains, consumption, and individual sales.*
[f] *Is obtained from input (Seeds, fungicide, DAP, urea) credit costs per ha as related in table 1.1.6.*
[g] *Is obtained by subtracting the cost of the technology from the gross revenues. This represents the net benefit generated from the adoption of the improved technology.*
[h] *Is obtained by dividing the net gains by the cost.*
[i] *Is computed based on weighted average price of 147 FCFA/Kg. Five sacks were sold at 15,000 FCFA, twenty sacks at 16,000 FCFA and twenty three sacks at 13,500 FCFA.*
Source: 2011 Farm Household surveys

The excellent yields obtained by Aouna producers in 2010 and the moderately attractive sale price after restitution through the association made highly profitable the adoption of Sepon 82. The association should be better trained to improve their marketing. They were instructed to put in more efforts in marketing activities and over time to invest in their own storage facilities from the profits of the farmers' association.

1.2 The sites of Maraka and Tourba

These two sites are under the same farmers' association located in Maraka and all major decisions are made in Maraka. Producers received their input credits and reimbursed them in Maraka. They face the same input credit cost and the same product prices at sale through the association.

For the 2010-2011 cropping season 40 ha of Sepon 82 were planted in the two villages (table 1.2.1). A total of 34 producers operating on 28.75 ha practiced monoculture of Sepon 82.

Table 1.2.1. Total area planted, area and number of producers surveyed under monoculture of Sepon 82 in Maraka and Tourba in 2010

	Total area planted (ha)	Area planted by monoculture producers in the survey (ha)	Number of monoculture producers in the survey
Maraka	25	17.75	18
Tourba	15	11	16
All two sites	40	28.75	34

Source: 2011 Farm Household surveys

Most of the new cultivar was planted on slopes and lowlands in Maraka. The excessive late rains in 2010 sharply reduced yields here. The on plateau site showed the effect one farmer was able to get with a large scale use of manure of 27 carts on his one ha (table 1.2.2).

Table 1.2.2. Sepon 82 planted on plateaus, slopes, and lowlands in Maraka

	Plateaus	Slopes	Lowlands
Yields	1,500	897	729
Number of farmers	1	9	8

Source: 2011 Farm Household surveys

1.2.1 The site of Maraka

1.2.1.1 Sorghum Yields from 2008 to 2010 in Maraka

The site of Maraka is known to have been prosperous in the earlier INTSORMIL program (2005-2007). The zone of Maraka is a good place to grow sorghum. Producers of Maraka have reported the highest mean Sepon 82 yields in the region for two years in a row in 2008 and 2009 at 1,543 kg/ha and 1,359 kg/ha (table 1.2.3). They also obtained the highest yields of the traditional sorghum variety for the 2008-2010 period among all sites of sorghum in the project.

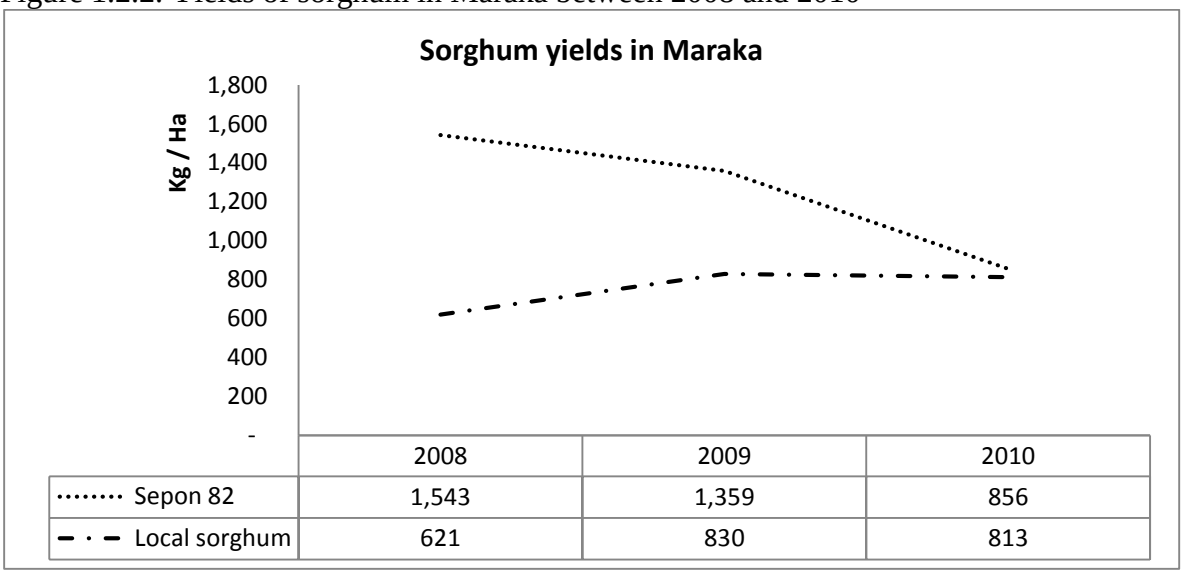
Those years of good Sepon 82 yields obviously influence farmers' decisions of where to allocate their crops. Overtime we would expect a concentration of Sepon 82 on the best lands, the lowlands; pushing more of the traditional sorghum to the slopes and plateaus. In 2010, the normal advantages of higher soil fertility and greater water availability on the lowlands were lost due to flooding. Hence, the collapsing of the yield differential is not surprising. Producers obtained approximately equal yields of sorghum for both the new cultivar and the local variety in 2010 (table 1.2.3).

Table 1.2.3. Average yields of sorghum varieties reported by producers in Maraka

Year	Crops	Number of Observations	Mean	Standard Deviation
2010	Sepon 82	18	856	530
	Traditional sorghum	13	813	724
2009	Sepon 82	17	1,359	605
	Traditional sorghum	11	830	904
2008	Sepon 82	13	1,543	1,014
	Traditional sorghum	7	621	511

Source: 2011 Farm Household surveys

Figure 1.2.2. Yields of sorghum in Maraka between 2008 and 2010



"Note: The number of observations for the improved sorghum is 13, 17, and 18 respectively in 2008, 2009 and 2010. The number of observations for the traditional sorghum is 7, 11, and 13 respectively in 2008, 2009 and 2010.
Source: 2011 Farm Household surveys

1.2.1.2 Factors affecting the yields of Sepon 82 in 2010 in Maraka

The entire sample surveyed has revealed a wide disparity between the agronomic recommendations and producers' practices on fields in 2010. About 31% of producers intercropped Sepon 82 with cowpeas and thereby reduced their Sepon 82 yields by 515 kg/ha (table 1.2.4). About a third of farmers applied manure and obtained an average yield of 1,075 kg/ha and increased their yields by 358 kg/ha. The use of mono-cropping and manure could increase the yield by 873 kg/ha[3]. Flooding also reduced yields by 151 kg/ha.

Table 1.2.4. Factors that affected yields the most in Maraka[4]

	Frequency		Average Sepon 82 yields (kg/ha)	
Factors	Yes	No	Yes	No
InterCropping of Sepon 82 with cowpeas	31%	69%	341	856
Flooding	44%	56%	732	956
Manure use	39%	61%	1,075[a]	717

[a] These farmers applied on average 17 carts of manure per hectare to complement the inorganic fertilizers. The most important applications were found on the slopes with an average of 18 carts of manure per hectare.
Source: 2011 Farm Household surveys

[3] Note that we did not analyze the economic impact of the cowpeas here.

[4] The mold-insect issue from late rainfalls did not show expected results. About 65% of Maraka farmers had that problem and reported 1,067 kg/ha whereas yields were lower with no mold-insect complex problem. In the latter group farmers reported an average of 913 kg/ha.

1.2.2 The site of Tourba

1.2.2.1 Sorghum Yields from 2008 to 2010 in Tourba

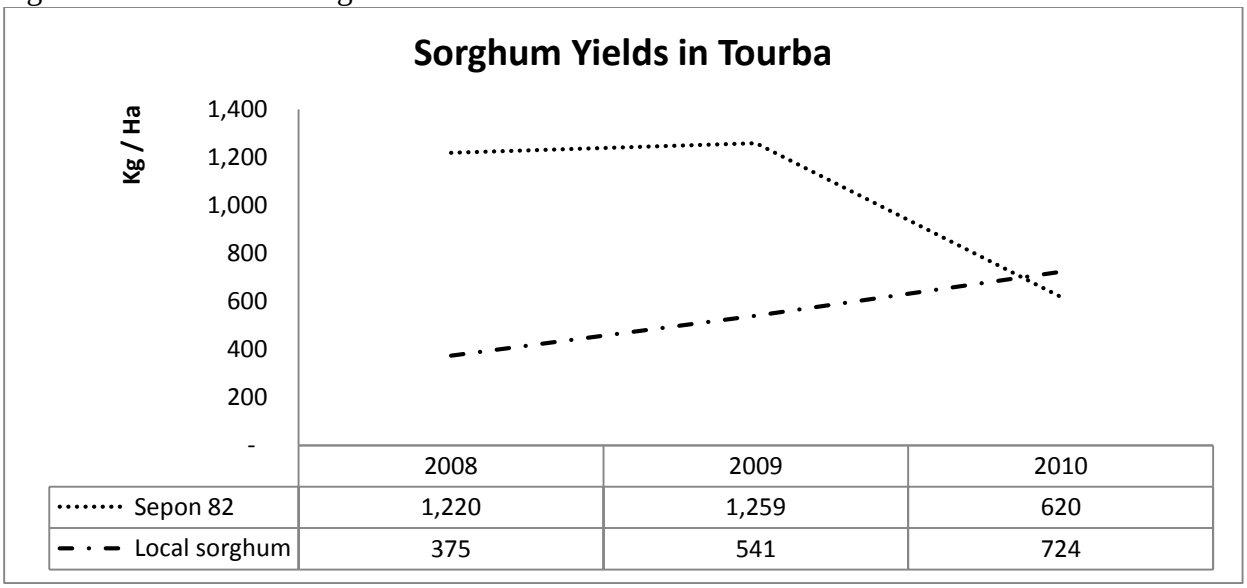
The pattern observed in Tourba is similar to that of Maraka. In 2008 and 2009, the Sepon 82 yields were excellent[5]. The yields of the Sepon 82 doubled those of the traditional sorghum variety. In 2008 and 2009, respectively 1,220 kg/ha and 1,259 kg/ha of Sepon 82 were obtained. In 2010, with the mold-insect complex and the concentration of production on the plateaus the average Sepon 82 yield was only 620 kg/ha. This is even lower yields than what they obtained for the local cultivar (724 kg/ha in table 1.2.5). Due to late arrival of the inputs over half of the area in the Tourba program was planted on the plateau.

Table 1.2.5. Average yields of sorghum varieties reported by producers in Tourba

Years	Crops	Number of Observations	Mean	Standard Deviation
2010	Sepon 82	16	620	527
	Traditional sorghum	16	724	497
2009	Sepon 82	7	1,259	771
	Traditional sorghum	6	541	386
2008	Sepon 82	2	1,220	1,104
	Traditional sorghum	2	375	212

Source: 2011 Farm Household surveys

Figure 1.2.3. Yields of sorghum in Tourba between 2008 and 2010



Note: The number of observations for the improved sorghum is 2, 7, and 16 respectively in 2008, 2009 and 2010. The number of observations for the traditional sorghum is 2, 6, and 16 respectively in 2008, 2009 and 2010.
Source: 2011 Farm Household surveys

[5] But note the limited number of observations obtained.

1.2.2.2 Factors affecting the yields of Sepon 82 in 2010 in Tourba

Intercropping Sepon 82 with other crops decreases yield on average by 200 kg/ha. The impact of mold was substantial. On average a yield increment of 300 kg/ha is obtained for Sepon 82 that did not suffer from the mold-insect complex (table 1.2.6). The use of manure increased yields by an average of 210 kg/ha. But the per cart increase was very small on the average of 12 kg/ha[6].

Table 1.2.6. Factors that affected yields the most in Tourba

	Frequency		Average Sepon 82 yields (kg/ha)	
Factors	Yes	No	Yes	No
InterCropping of Sepon 82 with cowpeas	11%	89%	419	620
Mold	81%	19%	568	848
Manure use	67%	33%	673[a]	463

[a] *These farmers applied on average 18 carts of manure per hectare to complement the inorganic fertilizers. The most important applications were found on the slopes with an average of 33 carts of manure per hectare.*

Source: 2011 Farm Household surveys

The main factor responsible for the low yields in Tourba was the concentration of the production on the poor soils of the plateau (56 % on plateaus, table 1.2.7). Only 38% (6 farmers) of the farmers planted on the slopes but those that did had substantially higher yields than those planting on the poor soils of the plateau. On the slopes yields were over a ton and 774 kg/ha more than on the plateau. As previously this was a major program failure of not getting the farmers the inputs on time. This can be corrected by getting the inputs to farmers early, by training farmers on the importance of combining more inputs with manure and finally by choosing fields' location on the better soils.

Table 1.2.7. Sepon 82 planted on plateaus, slopes, and lowlands in Tourba

	Plateaus	Slopes	Lowlands
Yields	324	1,098	426
Number of farmers	9	6	1

Source: 2011 Farm Household surveys

1.2.3 Gains in yields from the adoption of monoculture Sepon 82 in Maraka and Tourba

The yield difference between the improved and the traditional sorghum varieties is an increase of 5% in Maraka but a 14% decline in Tourba (table 1.2.8). Tourba is the only site where Sepon 82 yields were lower than the local variety but production was concentrated on poor soils in Tourba. However, on the slopes Sepon 82 yields in Tourba were substantially

[6] We return to the marginal impact of manure in the econometric analysis after this descriptive section.

higher than the local cultivar resulting in an improvement of 345 kg/ha or 46% increase. In this season with the flooding on the lowlands there was a definite advantage for planting on the slopes.

Table 1.2.8. Yield Gains from the Adoption of the monoculture Sepon 82 in Maraka and Tourba in 2010

	Sepon 82	Traditional sorghum	Yield difference	Yield Effect
Maraka	856	813	43	5%
Tourba	620	724	-104	-14%
Tourba slopes[a]	1,098	753	345	46%

[a] In this category we have Tourba farmers who planted Sepon 82 exclusively on slopes.
Source: 2011 Farm household surveys

1.2.4 Cost of the technological packages in Maraka and Tourba

The two sites are in the same association hence the cost of the technological package is identical at 32,200 FCFA/ha (table 1.2.9).

Table 1.2.9. Per hectare cost of the sorghum technological package in Maraka and Tourba

Items	Quantity (… /ha)	Unit cost of the item (… /ha)	Total cost of the item (FCFA /ha)
Sepon 82 seeds	8 Kg	400 FCFA/Kg	3,200
DAP	1 sack=50 Kg	14,250[a] FCFA/sack	14,250
Urea	1 sack=50 Kg	14,250[a] FCFA/sack	14,250
Fungicide	1 bag	500 FCFA/bag	500
Total			32,200

[a] The cost of fertilizer (DAP or Urea) is 13,500 FCFA/sack. The costs of transportation from Maradi are an additional 750 FCFA/sack of fertilizer.
Source: 2011 Farm Household surveys

1.2.5 Reimbursement and Marketing Strategies in Maraka, and Tourba

All producers repaid their input credits. The reimbursement of credit was 250 kg/ha in grain. After reimbursement, most of the grains were for family consumption and small portions were sold individually on local markets and through the farmers' association (Table 1.2.10).

Table 1.2.10. Averages of Sepon 82 reimbursed, sold and consumed by monoculture producers (kg/ha) in Maraka and Tourba in 2010

	Yield Sepon 82	Total reimbursement	Sold through the association	Total quantity in storage	Sold individually on local markets	Consumed
Maraka	856	250	40	290	14	552
Tourba	620	250	31	281	0	339
Tourba slopes	1,098	250	50	300	0	798

Source: 2011 Farm Household surveys

By later sales Maraka was able to increase price over the harvest price by 31% and Tourba by 15% (table 1.2.11). Given the poor yield performance they needed to do better in marketing. The farmers' association always runs the risk of the sale being arranged and for the benefit of a local marketing agent. This was clearly the case in Maraka in 2010 and is another one of the reasons for stressing the marketing function of the farmers' association.

Table 1.2.11. Storage and Quality effects on product prices in Maraka and Tourba

	Harvest price (FCFA/kg)	Sale price (FCFA/kg)	Price difference (FCFA/kg)	Price effect (%)
Farmers' association[a]	120	137.5	17.5	15%
Sold individually in Maraka[b]	120	157.5[c]	37.5	31%

[a] *This applies to both Tourba and Maraka.*
[b] *This only applies to Maraka. In Tourba there was zero kg/ha sold by monoculture producers.*
[c] *Represents the average price of Sepon 82 sold individually on local and neighboring markets by monoculture producers.*
Note: The members' association sold the reimbursed grains and surpluses in June (third week). The individual sales were distributed between December and March.
Source: 2011 Farm Household surveys

1.2.6 Profitability from the adoption of new sorghum technology in Maraka and Tourba in 2010

The adoption of new sorghum technologies was not profitable to producers in either Maraka or Tourba in 2010. This is explained by flooding in Maraka and the low soil fertility in Tourba. Note again that the inputs were late in arriving in Tourba so the good land was taken hence the concentration of production on the plateau (table 1.2.12).

These large losses are not surprising for Tourba given the concentration of area on the plateaus, the poorest soil areas. In contrast, a return to input investment of 75% was obtained on the slopes in Tourba. In 2012, on the lowlands farmers would have been adversely affected by the flooding which is the downside of this normally prime region.

Table 1.2.12. Per hectare gains from the adoption of monoculture Sepon 82 in Maraka and Tourba in 2010.

	Gains from increased yield FCFA/ha	Gains from grains sold FCFA/ha	Gains from consumption FCFA/ha	Gains from individual sales FCFA/ha	Gross revenue gains FCFA/ha	Cost of technological package FCFA/ha	Net gains FCFA/ha	Return on adoption
M	5,160	700	9,660	525	16,045	32,200	-16,155	-50%
T	-12,480	543	5,933	0	-6,005	32,200	-38,205	-119%
TS	41,400	875	13,965	0	56,240	32,200	24,040	75%

"M" stands for Maraka. "T" stands for Tourba. "TS" stands for Tourba slopes.
Source: 2011 Farm Household surveys

1.2.7 Conclusion

During the 2010 crop season, most of the Tourba farmers planted Sepon 82 on poor soils (plateaus) with no or little manure. Heavy rains caused flooding in the lowlands and this was a principal factor in Maraka reducing yields.

In years of low yields with adverse weather in the region the association attempts to compensate for lower yields with higher prices. However, the Maraka and Tourba (components of the larger Maraka association) did not benefit as the association did not find good marketing outlets. The marketing abilities of the associations and these sub-groups need to be improved to respond better to these adverse years.

In addition, the switch in 2011 to the use of two bags of NPK instead of one bag of DAP has increased the cost of new technology by more than 50%. These two factors led to the reduction in area planted to Sepon 82 in the old program. In Tourba, of the 15 ha cultivated to Sepon 82 in 2010 only 10 ha were planted in 2011.

On the marketing side, the associations had been dependent on Harouna Labo (the largest egg producer of Niger) and principal buyer of the Sepon 82. In 2010 Harouna decided to buy sorghum from Kano in Nigeria. Farmers were not prepared to search for another market but fortunately the association has a good storage facility. They waited, which was good, but they did not search out better markets and ended up selling through the local marketing people. With the increasing cereal prices and the food deficit in several regions, the Government of Niger decided in May to put cereals on the different markets at a moderate price. At that period with declining prices the association had to sell their products to buy inputs for the 2011 cropping season. The program advanced funds for Maraka enabling them to sell later at a price of 13,750 kg/sack in June 2011. But this still was not sufficient to make the overall activities profitable.

1.3 The site of Angoua Mata

Lands in Angoua Mata are very productive. Farmers in this village have had good sorghum yields in past years and also they have a comparative advantage with regard to their proximity to Maradi. This reduces transportation costs and hence the association and farmers have better chance to get higher prices for their products.

The association of Angoua Mata received 24 ha of input credits for the 2010 cropping year to cultivate Sepon 82.Men and women are involved in the Sepon 82 program. This is the only site of Niger where women planted Sepon 82. Women operated on 3 ha while men planted 21 ha. A total of 43 producers were mono-cropping Sepon 82 (table 1.3.1).Unfortunately both men and women apparently utilized the fertilizer on other crops. Even with flooding these are not credible yields. There are many other activities in Angoua Mata on which farmers like to utilize fertilizer. So farmers here consider this a fertilizer credit program. This is a major failure of farmer training and explanation of the program.

Table 1.3.1. Area planted, area surveyed and number of producers surveyed in Angoua

	Total area planted (ha)		Area planted by monoculture producers in the survey (ha)		Number of monoculture producers in the survey	
	Men	Women	Men	Women	Men	Women
Sepon 82	21	3	15.50	1.75	36	7
Total	24		17.25		43	

Source: 2011 Farm Household surveys

1.3.1 Sorghum Yields from 2008 to 2010 in Angoua Mata

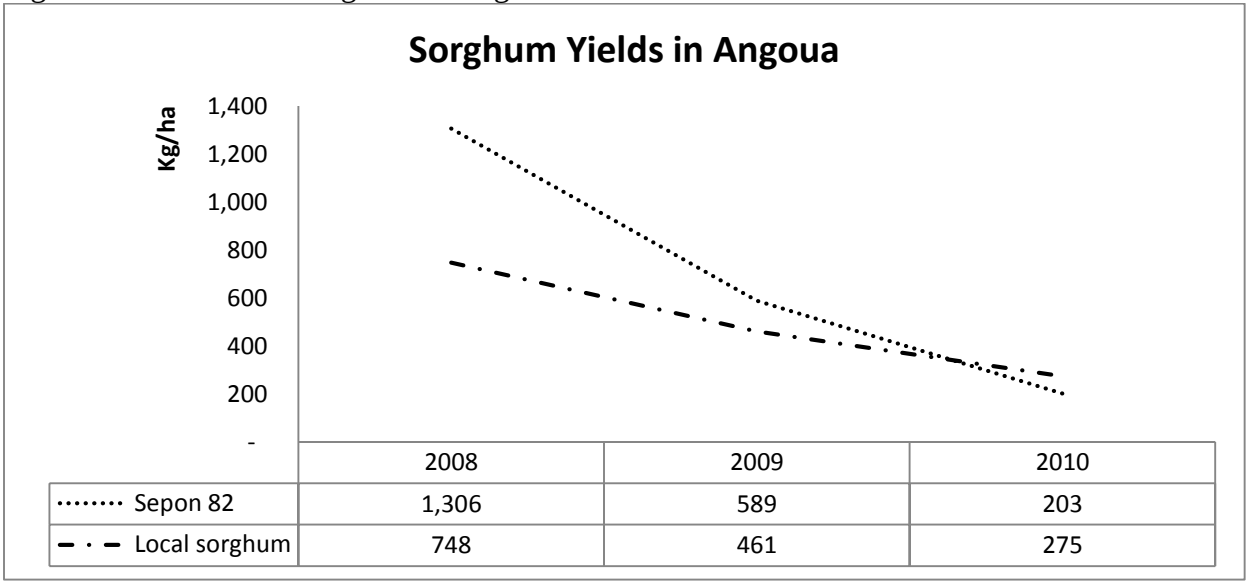
Producers of Angoua had the second highest Sepon 82 yield in 2008; the average was 1,306 kg/ha for men. In 2009 and 2010, Angoua producers obtained the lowest Sepon 82 yields among all sites in Niger. The average Sepon 82 yields were respectively 589 kg/ha and 203 kg/ha in 2009 and 2010 (table 1.3.2). With low yields these producers lost money in both 2009 and 2010 but still want to continue the program. Hence, they are undoubtedly using the fertilizer on other activities as producers have interpreted the program as fertilizer credits. They produce corn, peppers, and also tobacco for sale here. So, the economic evaluation of the adoption of Sepon 82 in Angoua is not done because we would not be evaluating the project activities where the fertilizer was used.

Table 1.3.2. Average yields of sorghum reported by producers in Angoua

Years	Crops	Number of Observations	Mean	Standard Deviation
2010	Sepon 82	47	203	257
	Traditional sorghum	29	275	338
2009	Sepon 82	35	589	697
	Traditional sorghum	20	461	463
2008	Sepon 82	16	1,306	693
	Traditional sorghum	9	748	583

Source: 2011 Farm Household surveys

Figure 1.3.1. Yields of sorghum in Angoua Mata between 2008 and 2010



	2008	2009	2010
Sepon 82	1,306	589	203
Local sorghum	748	461	275

Source: 2011 Farm Household surveys

Angoua is a high potential region for sorghum but we have to make sure the market outlets are working well and that the farmers understand the program. This was a high yield sorghum area in 2008 and can return again to that status with good program explanation and the linking to the markets and obtaining good prices.

Conclusion for the Mardi region

Over the period 2005-2010, the program has been a big success in the region of Maradi at improving sorghum yields and increasing farmers' revenues. Yields of Sepon 82 have been high except for the serious flooding problem on lowlands in 2010. Since the introduction of Sepon 82 by the project in 2005 in the Maradi region, only in 2010 did local cultivars compete with Sepon 82 in some regions. The decline in the production of the Sepon 82 in 2010 was primarily due to a high rainfall, flooding and then mold-insect problem with the late season rains. Further analysis of how these factors impacted Sepon 82 yields in 2010 are investigated in the next section utilizing econometrics.

It is necessary to renew the seed supply of Sepon 82. Farmers often evoked the issue of the quality of seeds because of the high level of off-types observed in fields. In the off-season of 2011-2012 Sepon 82 has been produced on isolated plots in Maradi and quality seed will be made available to the producers at the beginning of 2012 cropping year.

A continuing challenge anytime a new project is introduced is to orient the farmers sufficiently and convince them to follow the program. In many villages fertilization was not applied correctly or with the late reception of the inputs the area chosen were not the good soils of the lowlands. In this year there was an advantage to planting on the slopes but the plateaus are always low productivity. Moreover over most of the period the lowlands were the best site for the highest yields.

Another problem that needs to be overcome with farmers' identification and training is that the project is sometimes perceived as a fertilizer subsidy program in which producers can procure inorganic fertilizer at lower cost and put it on other crops such as maize, peppers, tobacco or sweet potatoes. This is a continuing problem of the program requiring regular field visits from the team to clarify the program objectives.

It is clear from this evaluation that more program effort needs to be put into the marketing activity. Farmers need to understand the marketing strategy of producing clean cereals, storing them and looking in a wide area for the best price. There is always the danger of the local or village merchant informing outside buyers and obtaining the cereal at a low price. To avoid this, the development of the farmers' association into a marketing coop with independent officers searching for the best alternative markets is critical. Previously Harouna Labo had been a principal buyer but as the program expands we will need to identify more buyers. The farmers' associations by selling in quantity can avoid the village and the regional middleman and look for the final buyers such as millet food processors and intensive chicken producers. But they should at least sell to the third stage of marketing beyond the local and regional buyer and consequently get the value added of their collection of small quantities, storage, price search and sale of large quantities

As the farmers' association is selling larger quantities they can sell at later stages of the marketing process and even to the processors of food products in Niamey. But they have to maintain quality, have reliable officials in the farmers' associations, and do the market searches. These sub-groups of the larger farmers associations are not the appropriate agencies to concentrate our marketing attention. We need to be dealing with the larger farmers association or creating new ones but attaining our desired size of 150 members.

II. Econometric analysis of factors influencing farmers' Sepon 82 yields in 2010

In this part of the bulletin, the objective is to determine factors that affect the yields of sorghum for the 2010 cropping year in the three sites (Aouna Da Kanka, Maraka, and Tourba). Linear regressions are run for the overall Maradi region and for each site. Three categories of variables were included in the regression models: topographical variables, agronomic performance measures, and stochastic effects.

The topographical variables are: planting on lowlands, slopes or plateaus. Measures of agronomic performance are the way the inorganic fertilizers are applied (side dressed or broadcasted), who did the application (by adults, or by kids), and the complementation of inorganic fertilizer by organic manure. Stochastic factors are floods, birds, and mold issues. The definition of variables used in the regressions and the expected signs on their coefficients (hypothesis) are presented in table 1 in the appendix.

2.1 Factors affecting Sepon 82 yields in the Maradi region as a whole

The results confirm higher yields on the slopes and plateaus. Yields were 379 kg/ha higher on the plateaus than on the lowlands since flooding was a problem in 2010 (table 2.1).

Sepon 82 yields were higher with manure application especially on the slopes (figure 1.2). The yields of Sepon 82 reported in figure 1.2 on the slopes with and without manure are respectively 1,217 kg/ha and 848 kg/ha. The marginal effect of manure did not come out to be

important in the regression, a low incremental increase of 14 kg/ha in yields for every cart of manure on the slopes.

However, farmers understand the role of adding organic material especially animal manure in their fields to improve the organic matter level. This reinforces soil structure by enabling better retention of water and nutrients especially on sandy soils. Manure also increases biological activity. The quality of the manure is not assessed here. Traditionally, farmers apply dried manure with low nutrient content especially due to the N being volatized in the sun (see Picture 1). Farmers need to make compost heaps and to water the manure to encourage bacterial activity. As a result, the manure quality could be improved.

Broadcasting is still a popular practice in the region and 65% of the producers were doing it. The effect of broadcasting on Sepon 82 yields is a reduction of 422 kg/ha as compared to the recommended side-dressing (table 2.1). About 1/3 of the fertilization was performed by kids. The application of fertilizer by kids reduces yields by more than 200 kg/ha (see picture 1). So fertilizer application side-dressed by adults is identified in the whole region as critical. Future agronomic training needs to focus on this.

During interviews farmers often discuss the effects of mold-insect complex and bird attack. Even though the coefficients of these two were not significant in the regression, they showed the expected negative sign.

Table 2.1. Determinants of Sepon 82 yields in the Maradi region in 2010

Parameter	Estimate	t Value	Averages or percent
Intercept	812***	7.49	
Slopes (Dummy)	304***	2.64	25%
Plateaus (Dummy)	379***	2.84	15%
Manure use on the slopes / carts per Ha	14***	2.74	13% of the total sample applied 26 carts/ha on slopes
Fertilizer BroadCasted	-422***	-4.26	65%
Fertilizer AppliedByKids	-208**	-2.29	38%
Mold (Dummy)	-59	-0.62	19%
Birds (Dummy)	-119	-1.11	68%

Note: Adjusted R-squared=0.33, number of observations=103, degree of freedom=95

Application of NPK by children. Nitrogen volatizes when exposed to sunlight.
Picture 1. Factors determining yields in the program in the Maradi region. Courtesy of Abdoulaye Ibrahim. Tourba (June 2011)

2.2 Factors affecting Sepon 82 yields in the site of Aouna Da Kanka

Here again the contribution of manure is small absolutely but highly significant. Flooding and the manure application had the most significant impacts on Sepon 82 yields. Flooding on lowlands caused a yield reduction of 589 kg/ha in 2010 but occurred on only a small fraction of farmers, only 15% of producers (table 2.2). Even with the flood effect, the average Sepon 82 yields reported by producers in this site are the highest in the Maradi region. This comes from better observance of the agronomic recommendations. More than three fourth (76%) of these farmers side-dressed the inorganic fertilizers as recommended by our agents. The potential yield increase from local placing (side-dressing) fertilizers either by adults or children is an improvement of more than 260 kg/ha (table 2.2). Again, the most important thing to work on in training the improved agronomy is the correct application of the fertilizer.

Table 2.2. Determinants of Sepon 82 yields in Aouna in 2010

Parameter	Estimate	t Value	Averages or percent
Intercept	858***	7.84	
Manure use/ carts per Ha	20***	5.93	31 carts / ha
*LowLands*YesFlood (Dummy interaction)*	-589***	-2.87	15%
*LowLands*NoFlood (Dummy interaction)*	-117	-0.63	38%
*SideDressing*AppliedByAdults (Dummy interaction)*	264*	1.98	38%
*SideDressing*AppliedByKids(Dummy interaction)*	261**	2.16	38%

*BroadCasting*AppliedByAdults (Dummy interaction)*	213	0.95	15%
Birds (Dummy)	-186	-1.54	8%

,,*** Significance levels at the 1%, 5%, and 10% respectively. 29% of lowlands flooded*
Note: Adjusted R-Squared=0.31, number of observations=26, degree of freedom =18. 77% of farmers side-dressed fertilizers in Aouna compared to 39% in Maraka and only 7% in Tourba. 12% of farmers applied manure in Aouna.

2.3 Factors affecting Sepon 82 yields in the site of Maraka

The two most important factors that affected Sepon 82 yields in Maraka in 2010 are the appropriate application of fertilizers and the bird attacks. Yields increased by 686 kg/ha when adults side-dress rather than children broadcast the inorganic fertilizers (table 2.3). The effectiveness and the yield response to inorganic fertilizers are maximized only when this task is done properly. Only 1/5 of the sample (22%) are following correctly this agronomic recommendation. With better training and learning by doing farmers can substantially increase yields.

Bird attack had also a substantial significant impact on Sepon 82 yields in 2010 in Maraka where a yield reduction of 635 kg/ha was reported with three fourth of the producers complaining about bird attacks (table 2.3). It is not as easy to do something about this but scarecrows and slingshots are often used on small farms.

The contribution of manure in increasing Sepon 82 yields is highly significant in Maraka but is still small marginally at 25 kg/ha from one cart of manure. About 40% of farmers applied manure with an average of 17 carts/ha (table 2.3). Surprisingly, the effect of flooding on the lowlands where 44% of farmers planted Sepon 82 was not significant but has the expected sign (table 2.3). So this may be sandier soils with fewer problems from flooding.

Table 2.3.Determinants of Sepon 82 yields in Maraka in 2010

Parameters	Estimate	t Value	Averages or percent
Intercept	702***	6.35	
Manure use/ carts per Ha	25***	5.23	17 carts / ha
*SideDressing*AppliedByAdults (Dummy interaction)*	686**	2.60	22%
*SideDressing*AppliedByKids (Dummy interaction)*	-422	-1.21	17%
*BroadCasting*AppliedByAdults (Dummy interaction)*	-32	-0.28	50%
Birds (Dummy)	-635*	-2.16	72%
LowLands (Dummy)	-104	-0.49	44%

,,*** Significance levels at the 1%, 5%, and 10% respectively.*
Note: Adjusted R-Squared=0.52, number of observations=18, degree of freedom=11. One producer planted on a plateau and was excluded from the analysis. There are only lowland and slope planted areas in this regression. 39% of producers applied organic manure.

2.4 Factors affecting Sepon 82 yields in the site of Tourba

This site did not suffer from flood effect. No farmland was located on lowland. None of the farmers reported birds' attacks, and only two producers recognized the mold-insect complex in their field. So the question is what is the reason for low Sepon 82 yields in this site?

Two important factors impacted Sepon 82 yields in Tourba: the choice of Sepon 82 field and who does the fertilizer application. Both of these factors are agronomic-related recommendations. More than half of these farmers were planting Sepon 82 on the most infertile soil, the plateaus where manure did not help. Farmers complained about inputs arriving late and their best land was already being used.

Tourba is the only site where this manure variable was not significant. Even the application of inorganic fertilizer on these nutrient depleted soils did not guarantee good yields. Farmers' decision to plant on plateaus caused a reduction in yields of almost 500 kg/ha (table 2.4).

The application of fertilizer was often done by children with no adult supervision. This has the cost of another 432 kg/ha yields reduction. The combined effect of the two factors, planting on the lowest fertility lands and the application of inorganic fertilizers by kids, is a 928 kg/ha yield decline (table 2.4).

Table 2.4. Determinants of Sepon 82 yields in Tourba in 2010

Parameter	Estimate	t Value	Averages or percent
Intercept	1,069***	3.16	
Manure use/ carts per Ha	9	1.56	18 carts / ha
Plateaus (Dummy)	-496*	-1.82	56%
AppliedByKids (Dummy)	-432**	-2.42	56%

,,*** Significance levels at the 1%, 5%, and 10% respectively.*
Note: Adjusted R-Squared=0.60, number of observations=15, degree of freedom=11. There are only plateau and slope planted areas in this regression as there was only one observation from the lowlands and this was excluded. Two reported mold, and none for birds' attacks. Only one farmer side-dressed fertilizers as recommended.

2.5 Conclusion

The answer to what are the factors that affected Sepon 82 yields in 2010 is clearly site-specific. But the common point to the three sites is the failure to follow the agronomic recommendations for the application of fertilizers. Since inorganic fertilizer is the most expensive inputs in this process and only moderate quantities are applied placement (side-dressing) and covering the fertilizer (often not done when children apply) are very important to obtain the benefits of fertilization.

With the heavy rains and flooding of 2010 yields on the preferred area for sorghum, the lowlands, were substantially decreased. Hence, planting on slopes had the greatest benefit for this particular year, 2010.

Surprisingly, the marginal effect of manure was not substantial but almost always significant. Mold and bird attacks also showed the expected signs and were in some cases significant.

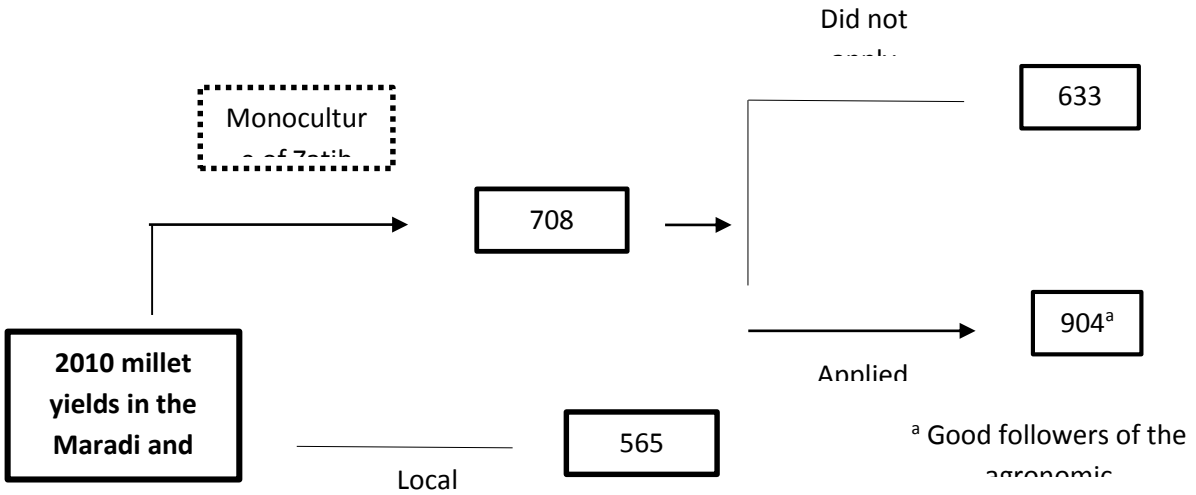
Part Two: The Improved Millet Variety, Economic Performance

III. Millet in the Maradi and Tillabery regions of Niger

Millet yields are very low in Niger. Millet is traditionally cultivated on slopes and plateaus with low soil fertility. Even in years of good rainfalls millet yields do not increase substantially due to low organic matter content. This makes it more difficult to increase productivity, the first goal of the program. In 2010 yields were generally poor in the lowlands with the high rainfall and flooding. Thus, this was a good year for those planting on the slopes where millet tends to be concentrated.

The mean yield of monoculture Zatib (708 Kg / Ha) is higher than that of the local millet variety (565 Kg / Ha). With the adoption of new millet technologies, yields increased to 708 kg/ha while applying manure increased yields to 904 (figure 3.1). The application of manure increased Zatib yields by 271 kg/ha. On the millet soils which are lighter and less fertile than the sorghum zones manure is especially important to hold water and fertilizers and to increase microbiological activity.

Figure 3.1. Average monoculture millet yield (Kg / Ha) distribution in the Maradi and Tillabery regions of Niger in 2010.



Source: Author's field survey 2011.

3.1 Millet yields in Maraka of the Maradi region

Note that in the village of Maraka both Zatib and Sepon 82 are cultivated; the former has been introduced in the program only in 2010. Maraka is the unique site where the program has implemented the possibility for women to grow Zatib in the region of Maradi. Men were required to cultivate Sepon 82 exclusively while women even though they had the choice between Sepon 82 and Zatib produced Zatib exclusively. However, from the interviews the survey results revealed that men planted Zatib as well; of the 10 ha programmed for women to cultivate Zatib, 4 ha were planted by men. Traditionally, millet is planted one day after the first rainfall. Since the improved millet variety has a shorter cycle, its planting date should be later than that of the local millet variety. Last year (2010), when the association received the cultivars, the women' fields that were programmed for Zatib were already planted with the local millet variety. For this reason, the farmers' association of Maraka composed only of men decided to allocate 4 ha of Zatib to men.

Table 3.1.1. Total area planted, area and number of producers surveyed under monoculture of Zatib in Maraka

	Total area planted (ha)	Area planted by monoculture producers in the survey (ha)	Number of monoculture producers in the survey
Zatib	10	5.25[a]	8

[a] *The survey covered the entire population of Zatib producers. 5.25 ha were under monoculture Zatib and the remaining 4.75 ha under association; 4 ha by 4 men and 0.75 ha by one woman. Source: 2011 Farm Household surveys.*

3.1.1 Millet yields in Maraka in 2010

The adoption of monoculture Zatib increased millet yield substantially. The followers of this recommendation are women and they reported respectively 870 kg/ha and 523 kg/ha for their improved and local cultivars (table 3.1.2).

Table 3.1.2. Average yields of millet reported by monoculture producers in the village of Maraka in 2010[7]

Crops	Number of observations	Mean	Standard Deviation
Zatib	8	870	320
Traditional millet	7	523	235

[7] The average Zatib yields reported respectively by female and male in Maraka are 1,010 kg/ha and 1,117 kg/ha. These are good but not great yields for millet with the favorable rainfall conditions for the slopes. Men were able to more than double the yield of local millet by cultivating the improved variety. Despite having access to poorer lands and less input, women obtained good millet yields for their first year of participation. The highest individual millet yields reported in Maraka were obtained by women for both the improved and traditional millet varieties. Less organic fertilizer is generally available to women. Moreover, they can apply labor to their field only after supplying the labor for the communal or family land. Given these constraints, women were better followers of the agronomic recommendations than the men.

Note: Men obtained 1,117 kg/ha. They associated cowpeas, so they are not part of this analysis.
Source: 2011 Farm Household surveys

3.1.2 Factors affecting the yields of Zatib in 2010 in Maraka

Two factors were found to be important in the determination of Zatib yields. There was an increase in Zatib yields when women complemented the application of inorganic fertilizer with manure. Women who applied manure in their fields harvested almost 200 kg/Ha additional to what their counterparts obtained (table 3.1.3). Women have access to poor or marginal lands. The percent increase in yields from the application of manure will be more important in marginal lands than in more fertile lands. Only one female out of nine reported cultivating cowpea conjointly with Zatib; the entire sample of men who planted Zatib in Maraka in 2010 did so in association with cowpea. Clearly, women followed more often the agronomic recommendations than men. Farmers that did the association, mainly men, reported higher Zatib yields (table 3.1.3) but had access to better land and more manure.

Table 3.1.3. Factors that affected Zatib yields the most in Maraka

	Frequency		Average Zatib yields (Kg/Ha)	
Factors	Yes	No	Yes	No
InterCropping of Zatib with cowpea[a]	38%	62%	1,321	870
Manure use by women	87%	13%	894[b]	700

[a] *All four men but only one woman interviewed revealed they intercropped Zatib with cowpea.*
[b] *They applied 8 carts of manure per hectare on average.*
Source: 2011 Farm Household surveys

3.1.3 Gains in yields from the adoption of monoculture Zatib in Maraka

Only monoculture Zatib producers are analyzed in subsequent tables. Since all men and only one woman producing Zatib associated another crop they were excluded from the analysis. The yield increase between the improved and the traditional millet variety was estimated at 66% increase for Zatib monoculture farmers (table 3.1.4). This lower performance of monoculture Zatib by women is explained by constrains evoked above (access to land, land quality, manure access, and labor constraints).

Table 3.1.4. Yield Gains from the Adoption of the monoculture Zatib in Maraka in 2010

	Zatib	Traditional millet	Yield difference	Yield Effect
Women	870	523	347	66%

Source: 2011 Farm household surveys

3.1.4 Cost of the Zatib technological packages in Maraka

The technological package of millet per unit of hectare cost 33,000 FCFA.

Table 3.1.5. Per hectare cost of the millet technological package in Maraka

Items	Quantity (… / Ha)	Unit cost of the item (… / Ha)	Total cost of the item (FCFA / Ha)
Zatib seeds	8 Kg	500 FCFA/Kg	4,000

DAP	1 sack=50 Kg	14,250[a] FCFA/sack	14,250
Urea	1 sack=50 Kg	14,250[a] FCFA/sack	14,250
Fungicide	1 bag	500 FCFA/bag	500
Total			33,000

Source: 2011 Farm Household surveys

3.1.5 Reimbursement and Marketing Strategies in Maraka

The reimbursement of the Zatib input credit was effective in Maraka. All men and women repaid in kind their credits. Monoculture Zatib producers did not sell any of their products through the association. Their principal use of their millet was to increase home consumption (455 kg/ha). They sold an average 165 kg / ha on local markets (table 3.1.6). This represents the highest average sale of grains after repayment of input credit in the region.

Table 3.1.6. Zatib reimbursed, sold and consumed by Maraka monoculture producers (kg / ha) in 2010

Yield Zatib	Total reimbursement	Total quantity in storage	Sold individually on local markets	Consumed
870	250	250	165	455

Source: 2011 Farm Household surveys

The price differences between the sale price and the harvest price of the improved millet are reported in table 3.1.7. Monoculture Zatib farmers of Maraka increased their revenue by respectively 35% and 37% from Zatib stored and sold through the association in the month of June and individually between March and May (table 3.1.7).

Table 3.1.7. Storage and Quality effects on product prices in Maraka

	Harvest price (FCFA/kg)	Sale price (FCFA/kg)	Price difference (FCFA/kg)	Price effect (%)
Farmers' association	115	155	40	35%
Sold individually	115	158	43	37%

Note: The farmers' association sold their stored grains from reimbursement and surpluses at the end of June. The individual sales of Zatib took place between March and the end of May.
Source: 2011 Farm Household surveys

3.1.6 Profitability from the adoption of new millet technology in Maraka in 2010

There is a substantial gain from the adoption of monoculture Zatib, a return on adoption of Zatib of 98% (table 3.1.8)

Table 3.1.8. Per hectare gains from the adoption of monoculture Zatib in Maraka in 2010.

Gains from increased yield FCFA/Ha	Gains from consumption FCFA/Ha	Gains from individual sales FCFA/Ha	Gross revenue gains FCFA/Ha	Cost of technological package FCFA/Ha	Net gains FCFA/Ha	Return on adoption
39,905	18,200	7,095	65,200	33,000	32,200	98%

Source: 2011 Farm Household surveys.

3.1.7 Conclusion

The disadvantage to sorghum of flooding on the lowlands meant that it was an excellent year for the millet on the slopes. The good Zatib yields recorded by participants in the program coupled with an acceptable sale price have driven up their revenue. Compared to Sepon 82, Zatib has shown excellent net revenues for monoculture producers in Maraka. Since millet is the principal staple food, over half of the production was kept for home consumption.

Women did a good job at improving their yields in spite of poor land, less access to manure, and constraints on their available time.

3.2 Millet in the Tillabery region

Three villages were part of the Zatib program in the Tillabery region in 2010, Boga 1, Boga 2, and Doutouwel. The sample interview covers only Boga 1 and Doutouwel. Producers of Boga 2 did not want to be interviewed because they had not repaid the input credits.

Only men are involved in the millet program in the Tillabery region. The three sites were in their first year of participation in the project. In Boga 1 farmers are not new to the use of fertilizer. The entire sample of producers interviewed in Boga 1 had small irrigated rice field[8] by the Niger River. The ONAHA (National Office of Hydro-Agricultural Developments of Niger), which regulates the irrigation of rice in the sector, requires the use of fertilizers. Hence, farmers are familiar with fertilizer.

Table 3.2.1. Area planted, area surveyed and number of producers surveyed in Tillabery

	Total area planted (Ha)	Area planted by monoculture producers in the survey (ha)	Number of monoculture producers in the survey
Boga 1	11	7.25	9
Doutouwel	20	8.30	17
Tillabery region	31	15.55	26[a]

[a] *A total of 37 farmers were questioned in the Tillabery region of which 26 reported they did monoculture Zatib.*
Source: 2011 Farm Household surveys

[8] The size of irrigated rice fields ranged between 0.25ha to 0.50ha.

3.2.1 Sample Yield Evaluation in the Tillabery region

The means of Zatib reported by surveyed producers are 407 Kg/Ha and 822 Kg/Ha in Boga 1 and Doutouwel respectively. In Boga 1 the average Zatib yield was 15% lower than the traditional millet and represents only half of the Zatib yield obtained by producers in Doutouwel (table 3.2.2). These yields are lower than the average Zatib yields reported in Maraka. This is explained by the sandy soil with low organic matter that characterized this region and by the failure to use the fertilizers on the millet.

Table 3.2.2. Average yields of millet reported by producers in Boga 1 and Doutouwel

Villages	Crops	Number of observations	Mean	Standard Deviation
Boga 1	Zatib	13	407	285
	Traditional millet	12	477	281
Doutouwel	Zatib	24	822	484
	Traditional millet	24	603	291

Source: 2011 Farm Household surveys

3.2.2 Factors affecting the yields of Zatib in 2010 in Tillabery

In this irrigated zone for rice clearly farmers are not using the fertilizer on the Zatib and/or using low quality lands. A third of farmers in the two villages agreed that their land where they planted the improved millet variety was of low fertility. Respectively 69% and 58% of producers in Boga 1 and Doutouwel agreed that they did not allocate their best lands to plant the improved millet variety (table 3.2.3). *The reason given was that the inputs arrived late*. An important group of producers, 46% in Boga 1 and 30% in Doutouwel, let their children do the fertilization. Usually, this results in the fertilizer not being covered and generally broadcasted rather than side dressed. More than a third of farmers had kids of less than 8 years old apply fertilizers (table 3.2.3). Only half of the sample side dressed the fertilizer, 6% broadcasted, and the remaining 44% mixed the fertilizer[9] with the seeds and then broadcasted or side dressed the fertilizer (table 3.2.3).

Table 3.2.3. Land allocation and the application of fertilizers in the Tillabery region (Frequency).

	Best land (No.Obsv)		Land productivity (No.Obsv)			The way the fertilizer is applied (No.Obsv)		Who applied the fertilizer (No.Obsv)	
	Yes	No	Good	Acceptable	Low	Side	Broadcast	Kid	Farmers
Boga 1	4	9	7	1	5	10	3	6	7

[9] By mixing the fertilizer with the seed the germination power/rate could be affected; this was the case in Boga 1 and Doutouwel where respectively 31% and 17% had to replant the Zatib for its non-germination.

Doutouwel	10	14	12	4	8	14	9	10	13

[a] *Farmers often mix their cultivars with fertilizers.*
Source: 2011 Farm Household surveys

Farmers in this region faced also a period of drought at the beginning of the season in 2010 which led to poor germination. More than a quarter reported a drought issue in Doutouwel and obtained an average Zatib yield of 658 kg/ha which is 25% lower than the average Zatib yield of farmers that did not face a drought (table 3.2.4).

Manure use is recommended to producers in the program. Organic fertilizer generally is necessary on these sandy soils to have a payoff to inorganic fertilizer so that the soil structure is sufficiently improved to take advantage of the inorganic fertilizer and rainfall. Only one producer in Boga 1 but three in Doutouwel used organic manure from the entire sample interviewed. The yield difference between those that apply manure in their Zatib fields and those that did not is over 100 Kg/Ha in Doutouwel and 60 Kg/Ha in Boga 1 (table 3.2.4). A larger proportion of producers intercropped the improved millet variety with cowpea (31% in Boga 1 and 29% in Doutouwel).

Table 3.2.4. Factors that affected yields the most in the Tillabery region (Frequency).

	Village of Boga 1				Village of Doutouwel			
	Frequency		Average Zatib yields (kg/ha)		Frequency		Average Zatib yields (kg/ha)	
	Yes	No	Yes	No	Yes	No	Yes	No
Manure use	1	12	463	402	3	21	925	808
Intercropping	4	9	318	446	7	17	763	847
Drought	2	10	350	459	7	17	658	890

Source: 2011 Farm Household surveys

3.2.3 Gains in yields from the adoption of Zatib

The differences in yields between the improved monoculture millet variety and the traditional millet were respectively 12% and 29% increase in Boga 1 and Doutouwel in 2010 (table 3.2.5).

Table 3.2.5. Yield Gains from the Adoption of the monoculture Zatib in 2010 in the Tillabery region

	Average Zatib yield (kg/ha)	Average traditional millet yield (kg/ha)	Yield Difference (kg/ha)	Yield Effect (%)
Boga 1	446	400	46	12%
Doutouwel	847	657	190	29%

Source: 2011 Farm Household surveys

3.2.4 Cost of the technological package

The technological package of Zatib cost 31,500 FCFA/Ha (table 3.2.6).

Table 3.2.6. Per hectare cost of the millet technological package in Boga 1 and Doutouwel

Items	Quantity (… / ha)	Unit cost of the item (… / ha)	Total cost of the item (FCFA / ha)
Zatib seeds	8 kg	500 FCFA/Kg	4,000
DAP	1 sack=50 Kg	13,500 FCFA/sack	13,500
Urea	1 sack=50 Kg	13,500 FCFA/sack	13,500
Fungicide	1 bag	500 FCFA/bag	500
Total			31,500

Source: 2011 Farm Household surveys

3.2.5 Reimbursement and Marketing Strategies in the Tillabery region

The reimbursement rate in the two villages is satisfactory indicating for Boga 1 that farmers were using the fertilizer on their other activities. Otherwise, why would they want to continue the program? All producers that received the input credits in 2010 reimbursed their input credits in kind 200 Kg/Ha (table 3.2.7). The quantity of Zatib repaid per hectare is not as high as in the Maradi region.

Table 3.2.7. Zatib reimbursed, sold and consumed by monoculture producers (kg / ha) in 2010 in the Tillabery region.

	Yield Zatib	Total reimbursement	Sold through the association	Total quantity in storage	Consumed
Boga 1	446	200	0	200	246
Doutouwel	847	200	12	212	635

Source: 2011 Farm Household surveys

Again the main use of millet after repayment was for home consumption. Millet is easily sold on markets compared to other staples in Niger. Farmers sold their products at a good market price which allows them to cover the input credits from the sale of two sacks for each hectare. The harvest price was 12,000 FCFA/sack of Zatib but the associations sold the products respectively at 18,000 FCFA/sack and 17,500 FCFA/sack in Boga 1 and Doutouwel (table 3.2.8). Even though the average yield of Zatib was lower in the Tillabery region than in Maradi, farmers sold their products at a higher price with the proximity of a larger market area of Niamey, the capital city of Niger.

Table 3.2.8. Storage and Quality effects on product prices in Boga 1 and Doutouwel

	Harvest price (FCFA/kg)	Sale price (FCFA/kg)	Price difference (FCFA/kg)	Price effect (%)
Boga 1	110	180	70	64%
Doutouwel	110	175	65	59%

Source: 2011 Farm Household surveys

3.2.6 Profitability from the adoption of monoculture Zatib in the Tillabery region in 2010

Clearly farmers in Boga 1 did not fertilize their millet and will be eliminated from the 2012 program. The net gain found in Doutouwel is encouraging and is evaluated at 31,455 FCFA/ha; this seems to be a good result for a first year participation in the program. The returns on adoption of the improved millet variety were 100% in Doutouwel and -29% in Boga 1 (table 3.2.9).

Table 3.2.9. Per hectare gains from the adoption of Zatib in Tillabery.

	Gains from increased yield FCFA/Ha	Gains from grains sold FCFA/Ha	Gains from consumption FCFA/Ha	Gains from individual sales FCFA/Ha	Gross revenue gains FCFA/Ha	Cost of technological package FCFA/Ha	Net gains FCFA/Ha	Return on adoption
B	5,060	0	17,220	0	22,280	31,500	-9,220	-29%
D	20,900	780	41,275	0	62,955	31,500	31,455	100%

"B" stands for Boga 1 and "D" stands for Doutouwel.
Source: 2011 Farm Household surveys

3.2.7 Conclusion

For the case of millet, an improvement in yields played an important role on revenue. The price of millet is high in bad weather year (excessive rain for sorghum in 2010).

Farmers that followed the program in Doutouwel did reasonably well in increasing incomes. There was very poor site selection and supporting services to Boga 1 and 2. Areas with irrigated rice are expected to concentrate their attention on the irrigated areas rather than dry land millet and undoubtedly most of the fertilizer ended up on irrigated areas or in other better soil areas according to the farmers own description of where they planted.

A more detailed analysis of the low Zatib yields is explored in the next section. This relies on econometric regressions including agronomic and non-agronomic measures.

IV. Econometric analysis of factors influencing farmers' Zatib yields in 2010

The objective is to determine factors that influence Zatib yields for the 2010 cropping year for the three millet sites (Maraka, Boga1 and Doutouwel) already covered in the first section of this part II[10].

About a fifth of producers practiced tied ridging to harvest rainfall water. They thereby increased their grain yields by 252 kg/ha. Manure application had the right sign but a very small yield effect (table 4.1). With better use on sandy soils with inorganic fertilizer we would expect

[10] A linear regression is run for the overall region and for each site. For definition of variables used in the regression refer to table 1 in the appendix.

much better results showing that the organic and inorganic fertilizers are complements rather than substitutes. The other two agronomic variables in the model were not significant but their coefficients had the right signs.

Table 4.1. Determinants of Zatib yields in Niger in 2010

Parameter	Estimate	t Value	Averages or percent
Intercept	721***	5.45	
Manure use/ carts per Ha	10***	3.35	15 carts / ha
TiedRidges (Dummy)	252*	1.69	21%
Fertilizer BroadCasted	-62	-0.40	38%
Fertilizer AppliedByKids	-113	-0.71	41%

,,*** Significance levels at the 1%, 5%, and 10% respectively.*
Note: Adjusted R-Squared=0.16, number of observations=34, degree of freedom=29.

Conclusions

This report highlights the success story of the Production-Marketing project in Niger from the adoption of new technologies of sorghum and millet. For years, these objectives were reached and many producers joined the program. During our absence in 2008 and 2009 not only did the program continue with the revolving funds but also producers in most regions were recording high yields.

It has been a challenge to persuade new adopters of the technologies to follow the agronomic recommendations. What explains this behavior? And what is the remedy? An intuitive answer would be producers just don't believe a new technology without experiencing it. Regular field visits will increase the number of good followers who will be the elites. Overtime, most producers' skills will improve by imitating better followers.

In the Maradi region, the most fertile soils are in the valleys. Better followers of the recommendations will cultivate their highest yielding crops and new technologies in the valleys. In 2010, the flood on lowlands and the late mold-insect complex had an especially serious effect on sorghum yields. So in this year the lowlands suffered while the slopes and plateaus did well.

Recommendations

Some recommendations are derived for controllable factors. There is evidence from field trips that producers often do not point-place or side-dress inorganic fertilizers. The data also support that farmers usually let their kids apply inorganic fertilizers. This is often done badly by kids especially not covering the fertilizers (see picture 1).

The complementarity of manure with inorganic fertilizers will depend on the availability of the manure. When applied on improved varieties farmers will rapidly shift most of their manure to increase Sepon 82 or Zatib yields.

The choice of the most productive land to the production of the improved variety is being followed by many farmers but new adopters are reticent to do so. Also inputs for sorghum and millet often arrived late in 2010. With inputs arriving on time and experience with the improved agronomy farmers will allocate their best productive lands to the cultivation of the improved varieties (Sepon 82 on lowlands) and return to the high yield levels. Sepon 82 is being renewed and Grinkan from Mali introduced in 2012.

Appendix

Table 1. Meaning of variable used in the regression models and expectations

Variables	Definition of variables	Effect on yield and hypothesis
LowLands	Dummy variable. Whether or not the improved variety is planted on lowlands	Because of flooding on lowlands, Sepon82 yields are higher on the slopes than on the lowlands. Because of good rainfalls, Sepon 82 yields are the highest on the slopes. For the case of Zatib, yields on the slopes are greater than on the plateaus.
Slopes	Dummy variable. Whether or not the improved variety is planted on slopes	
Plateaus	Dummy variable. Whether or not the improved variety is planted on plateaus	
SideDressing	Dummy variable. Whether or not farmers side dressed the fertilizers	Compared to side dressing, broadcasting reduces Sepon 82 yields. Yields from broadcasting will be lower than from side-dressing.
BroadCasting	Dummy variable. Whether or not farmers broadcasted the fertilizers	
AppliedByAdults	Dummy variable. Whether or not farmers applied the fertilizers themselves in the field	Children often do the application of inorganic fertilizers wrongly. Yields when fertilizers are applied by kids lower than when applied by adults.
AppliedByKids	Dummy variable. Whether or not kids were in charge of applying the fertilizers in the field	
ManureHa	Continuous variable. Number of carts of manure per ha	+. The more manure application, the higher the yield.
Flood	Dummy variable. Whether or not there was flood issue	-. Flood decreases yields.
Mold	Dummy variable. Whether or not there was mold issue	-. Mold decreases yields.
Birds	Dummy variable. Whether or not there were birds' attacks.	-. Birds' attacks reduce yields.
TiedRidges	Dummy variable. Whether or not farmers perform this technique to harvest rainfall water.	+. By doing tied ridges, yields of the increased variety will increase.

Tables 2 and 3 show the importance of planting Sepon 82 on slopes in excess rainfall year, the negative impact of kids applying inorganic fertilizers on yields, and the higher yield reported by Aouna producers. As shown in part one of this bulletin, Aouna has the highest Sepon 82 yield followed by Maraka producers. Even Tourba where producers planted Sepon 82 on the infertile plateau soils has out-yielded Angoua where farmers were not applying the inorganic fertilizers on Sepon 82 (table 3). This has an important implication. When farmers fail to adopt one component of the program technology package (improved seeds, inorganic fertilizers, and agronomic advices) their yields dramatically decline.

In Angoua, farmers failed to apply inorganic fertilizers on Sepon 82 while producers in Tourba failed to follow the agronomic recommendations. As a result, these two sites reported the lowest Sepon 82 yields observed in the analysis (table 3).

Table 2. Determinants of Sepon 82 yields in Maradi in 2010 excluding Angoua Da Kanka

Parameter	Estimate	t Value	Averages or percent
Intercept	601**	2.48	
Slopes (Dummy)	360**	2.62	37%
Plateaus (Dummy)	104	0.53	25%
Fertilizer BroadCasted	-124	-0.82	53%
Fertilizer AppliedByKids	-252**	-2.08	43%
Mold (Dummy)	102	0.71	68%
MARAKA (Dummy)	152	0.71	30%
AOUNA (Dummy)	373**	2.05	43%
TOURBA			

Note: Adjusted R-Squared=0.17, number of observations=60, degree of freedom=52.

Table 3. Determinants of Sepon 82 yields in Maradi in 2010 including Angoua Da Kanka

Parameter	Estimates	t Value	Averages or percent
Intercept	200*	1.76	
Manure use/ carts per Ha	11***	3.88	19 carts / ha
Slopes (Dummy)	167*	1.67	25%
Plateaus (Dummy)	44	0.33	15%
Fertilizer BroadCasted	-77	-0.80	65%
Fertilizer AppliedByKids	-219***	-2.80	38%
Mold (Dummy)	-8	-0.10	68%
Birds (Dummy)	71	1.02	19%
MARAKA (Dummy)	604***	5.57	17%
AOUNA (Dummy)	840***	7.28	25%
TOURBA (Dummy)	381**	2.50	15%
ANGOUA			

*. *,**,*** Significance levels at the 1%, 5%, and 10% respectively.*
Note: Adjusted R-Squared=0.58, number of observations=103, degree of freedom=92.

References

Abdoulaye, Tahirou, John Sanders and Botorou Ouendeba, 2007. *Revenus des Producteurs: Effets des Technologies et des Strategies de Marketing.* INTSORMIL Bulletin n° 5. Department of Agricultural Economics, Purdue University, West Lafayette, IN, 18 pages. Summary of field results for the 2005 crop year in Senegal, Mali and Niger.

Abdoulaye, Tahirou, John Sanders, and Botorou Ouendeba, 2008. *Evaluation of Sorghum and Millet Technology and Marketing Strategy Introduction: 2006-07 crop year*. INTSORMIL Bulletin n° 8. Department of Agricultural Economics, Purdue University, West Lafayette, IN, 24 pages. Summary of field results for the 2006 crop year in Mali, Niger and Senegal.

Baquedano, Felix, Mamoutou Diarra and Aly Ahmoudou, 2009. *Economic Analysis of the 2007 Crop Year*. INTSORMIL Bulletin n° 9. Department of Agricultural Economics, Purdue University, West Lafayette, IN, 35 pages. Summary of field results for the 2007 crop year in Mali.

Coulibaly, J., 2010. *Evaluation des Technologies de Production et de Commercialisation du Sorgho et du Mil dans le Cadre du Projet IER-INTSORMIL, Campagne Agricole 2008-2009.* Bulletin IER-INTSORMIL n°10. Department of Agricultural Economics, Purdue University, West Lafayette, IN, 36 pages. Summary of field results for the 2008 crop year in Mali.

Coulibaly Y. J., G. Kumaraswamy, and J.H. Sanders. Forthcoming. *Economic Impact of Sorghum and Millet Technologies and Marketing in Mali*. IER-INTSORMIL Bulletin n° 11. Department of Agricultural Economics, Purdue University, West Lafayette, IN, 36 pages. Summary of field results for the 2010 crop year in Mali.

ACKNOWLEDGEMENTS

Acknowledgements are given to various people who helped throughout the field data collection and different institutions involved in this process. This study could not have been conducted without the entire financial support from the International Sorghum and Millet (INTSORMIL), the McKnight Foundation, and the United States Agency for International Development (USAID-West Africa). It was also facilitated by the involvement of agents from the National Agronomic Research Institute of Niger (INRAN) and the International Crops Research Institute for the Semi-Arid Tropics in Niger (ICRISAT).

The authors would like to recognize constructive comments from Kaka Saley (INRAN-Niamey employee), Magagi Abdou (INRAN-Maradi employee) and Nouri Mamane (INRAN-Maradi employee). Their remarks and critics during the stay of the graduate student in Niger have been very valuable for his first field data collection of this type. Special thanks to Soumaila Babaye,

an INRAN technician agent, who spent time with the graduate student in villages in the Maradi region of Niger and showed hardship in work throughout the field days.

Recognitions to Abdou Kimba the president of the farmers' association in Maraka, Zouera Rabe, Dela, Delou Moussa, Tourey Mati, Rabi Malam Issa, El Hadj Garba Issa the President of the farmers'association in Tourba, Issa Gambo Maigari, Seydou Issa, Labo Alkassoum, Aliko Habou, Elhadj Idid Nayayanka vice president of the farmers'association in Aouna da Kanka, Abdou Amadou Tchindo, Sandari Amadou, Lamine Issa the president of the farmers' association in Doutouwel and Ali Abdoulaye.

Appreciations toward Harouna Labo the largest egg producer in Niger for a tour in his farm and sharing information about his business, Bouzou the local extension agent in Gabi, Zibo the extension agent for Boga 1 and Boga 2, and Halidou Djibo the extension agent for Doutouwel.

Producers in all villages were collaborative and we show gratitude for their available time at crucial season periods. Credits to all producers involved in the program and to those who did not read their names.

And lastly, to the most careful driver, Boureima, who drove us around during the length of the mission and the sunny field days in Niger and Burkina Faso.

Pictures on back cover: clockwise. Top left, a young girl preparing the field outside of Maraka village. Down left, Delou Moussa took us to her Zatib field about 2miles away from Maraka village. Down right, success story of the president of Tourba ElHadj Garba Issa. He made good profit from the adoption of Sepon 82 technologies and accomplished the Pilgrimage to Mecca and also is running his own business (mill) in the village of Tourba. Top right picture, Toureye Mati working in her Zatib field, Maraka. Maradi, Niger 2010. Back cover pictures are the courtesy of Abdoulaye Ibrahim Djido.