OAU/STRC - SAFGRAD

Semi-Arid Food Grain Research and Development

Scientific, Technical and Research Commission of the Organization of African Unity

Highlights of Agricultural Technologies Transfer Activities 1999 - 2000

Sustainable Agriculture Development Program :
Intensification of Food Grain Production in Semi-Arid West and Central Africa

Funded by African Development Bank (ADB)

August 2001

CONTENTS

Sustainable Agricultural Program for the Intensification of Food Grain Production in Semi-Arid West and Central Africa

Highlights of Agricultural Technology Transfer Activities

1999-2000

Executive Summary

This report highlights the preliminary activities of the Sustainable Agricultural Development Program for the intensification of food grain production in Semi-Arid Africa. Ten countries are benefiting from this program.

The main goal of the program is to intensify the production of food to meet the challenges of food security through the delivery of technology options that minimizes environmental degradation. Because the ADF Grant was received in September 1999, and to take advantage of the season, SAFGRAD prefinanced to start program activities in Burkina Faso, Mauritania and Niger.

In Niger, 103 farmers participated in the testing of four maize varieties suitable as green maize. It appeared that P3 Kollo and EV 84-SR were identified and preferred by farmers across all four regions. For cowpea, 30 farmers were involved in the on-farm trial. Strong positive reaction of farmers to the introduced varieties sparked seed multiplication in order to meet farmers' demand.

In Mauritania, both maize and cowpea varieties were tested under dryland and irrigated conditions. The technical data is being analyzed.

In Burkina Faso, 24 producers experimented integration of legumes in their cropping system as well as small ruminant fattening. The cultivation of improved cowpea cultivars generated return to farmers of about 80 000 CFA/ha. But, the combination of cowpea production and fattening of small ruminants improved the return of income to

more than 195 277 CFA. Meanwhile, cowpea/cereal rotation improved yield of the latter by up to 30%.

In both Togo and Benin, farmers in these countries express the desire to adopt the improved varieties of sorghum and maize verified on-farm. Core activities in Ghana and Senegal and Nigeria included the integration of small ruminant production with cereal and legume cultivation. Initial results suggests that the technologies proposed by research is adequate for the various farming systems.

In Cameroon, on-farm Striga research indicated that the use of tolerant/resistant maize varieties in striga control is promissing. Similarly, the use of trap crops wether in rotation or in association with striga tolerant or resistant maize varieties is a plausible alternative for striga management.

It is anticipated, in the long run, that this program will generate income and employment for improving the livelihood of millions households in Sub-saharan Africa.

1. Introduction

Today, because of high population growth in Africa, many economists predict that Sub-Saharan Africa (SSA) will not be able to feed its population unless agricultural growth triples. By in large, food production in many African countries did not keep pace with the increasing population. Attaining food security is a formidable challenge in many countries. On-going research efforts by NARS, the IARCs and other research organizations have generated several options of technologies which are yet to reach the end-users because of socio-economical constraints. At the same time, a lot remains to be done to improve soil fertility and preserve the environment. There is urgent need to capitalize on the existing suitable varieties of maize, sorghum, millet, cowpea, groundnut etc, on soil fertility management strategies (use of organic matter, legume based cropping system, etc..), and appropriate agronomic practices and water and soil conservation strategies to improve food production and productivity while conserving the environment.

The goal of the program is to improve the livelihood of farm households by accessing and delivering more productive technologies that substantially increase agricultural productivity, while concurrently improving soil fertility in a sustainable manner. The main components of the program are:

Component 1: The Verification of Food Grain Production Technologies

The program is tailored to strengthen National Agricultural Rechearch System (NARS) and extension capabilities in the evaluation and verification of more productive food grain production technologies in the participating countries (Benin, Cap Verde, Mauritania, Niger, and Togo) through agronomic trials.

The objectives pursued through this component include:

- Narrowing the "yield gap" of performance of technologies between on-station and on-

farmers field;

- Facilitating linkage and partnership between research, extension and other end-users of agricultural technologie;
- Diversifying agricultural production to both enhance food security and the generation of income; and
- Identifying agronomic practices that could minimize risks of crop failures due to environmental and socio-economic constraints.

Component 2: On-Farm Resource Management

This program has been to enable participating countries develop packages of technology based on the efficient management of on-farm resources. These include the integration of cereal/Legume/livestock production systems such as mixed cropping, crop rotation, raising of small ruminants, utilization of compost and improve the efficicency of the use of chemical and fertilizers. The participating countries include Burkina Faso, Cameroon, Ghana, Nigeria, and Senegal.

The objectives pursued through the component are:

- To improve the management efficiency of an integrated on-farm enterprises which can lead to the use and the recycling of on-farm resources and to concurrently induce both agronomic (biological) and economic complementarities between and among production systems;
- To access environmentally friendly, but more productive technologies to farms communities, in order to enhance the management of agricultural production and natural resources;
- To strengthen partnership among stakeholders including farmers, technology transfer agents, researchers, NGOs, the public and the private sector, etc. to improve the fertility of the soil and to enhance the development of the sustainable agriculture; and
- To diversify sources of food security and income of farm households by linking

agriculture to market sources and food industries.

Operationally, the program seeks to promote the participation of all stakeholders including farmers, extension agents, researchers, NGOs, the public and private sector in the development of sustainable agricultural production systems.

The program was launched in summer 1999 in Niger and Mauritania, and full activities in all participating countries were initiated after the planning workshop held from 3-4 April 2000 in Ouagadougou, Burkina Faso. The overall activities which are funded by the African Development Bank (ADB) are listed in Table 1.

Table 1: Project sites and technologies options evaluated in the ten Participating countries

Country	Project sites (villages)	Number of farmers managing trials		Farmers having access to trials	Technological options verified
		1999	2000		
Benin	5	-	29		4
Cap Verde	6		19		4
Mauritania	9	46	46		4
Niger	26	100	150		3
Togo	15		50		3
Burkina Faso	12		36	226	7
Cameroon	14		21		3
Ghana	3		25		4
Nigeria	6	-	24		8
Senegal	7	-	11	69	4

This report highlights activities of the program and finding between July 1999 to December 2000.

A. Verification of food grain production technologies

Togo : New sorghum varieties enhance food security and income

The project was implemented in the department of Tone and Tandjouare (**Fig. 1**). The population density in the region varies between 25 and 200 inhabitants per km2. Soils are generally poor and most crops necessitate fertilization. Access to land is problematic and people resort to leasing of land for production. Traditionnally, cereals such as sorghum, millet and maize are produced as sole or in association with legumes. Rotation is practiced mostly between cotton and cereal. There is some level of integration between agriculture and livestock production.

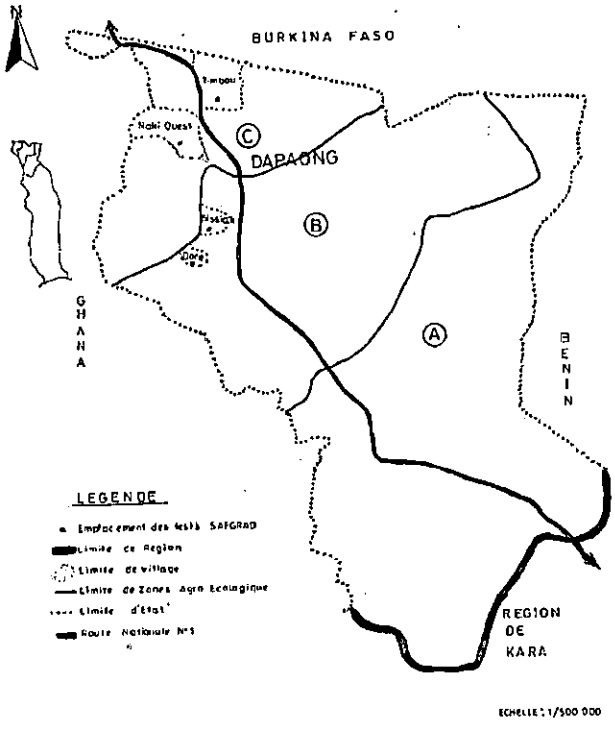


Figure 1: Map of Northern Togo showing the test sites

Sorghum is used for food (to) and for local beer, which is highly appreciated. The cultivation of the crop is widespread in the region (55% of cropped land). In recent years,

the local varieties have shown poor adaptation to the climatic conditions characterized by irregular rainfalls and shortened periods of precipitation. Food security in this region also depend on sorghum production. The Togo NARS (ITRA) has developed early maturing sorghum varieties, Sovarto1 and Sovarto 28 (**Fig. 2 & 3**). These two varieties of sorghum are characterized by a vigorous vegetative growth, good compact spikes, high yield as well as good organoleptic quality.

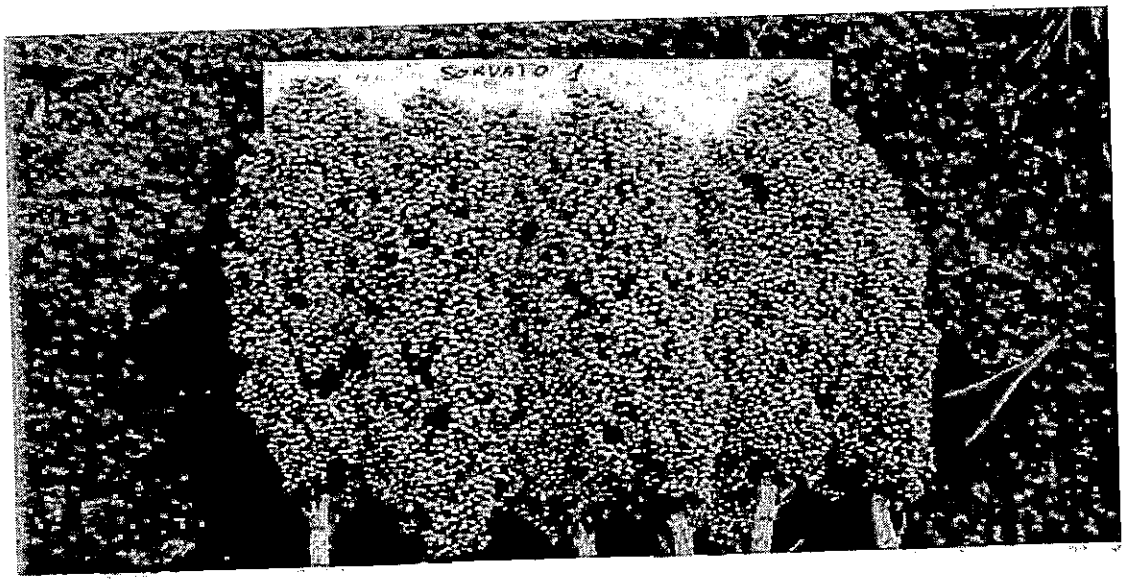


Figure 2: Spikes of Sorvato 1

Figure 3: Farmer happy to harvest so much grain of Sorvato 28 on a small plot

The African Development Fund of ADB technical support promoted the verification and diffusion of early maturing sorghum cultivars. For that effect, Sorvato1 and 28 were evaluated on-farm under farmer practices and compared with the farmer variety.

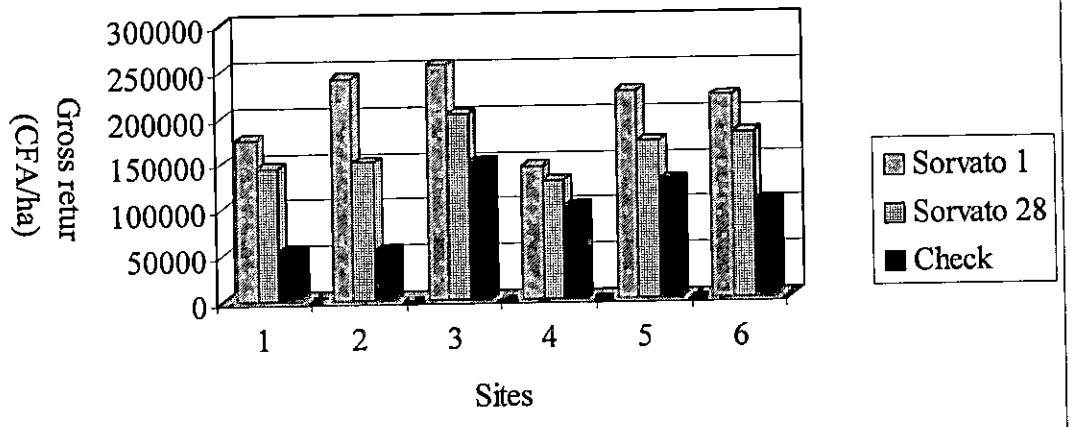
In Timbou, in the Tone department, the new sorghum varieties Sorvato 1 and 28 outyielded local cultivars (Kadag) both under sole cropping and intercropping with cowpea. Yield advantage of Sorvato 1 and 28 over Kadag were more than 700 kg per ha on the average about 31% increase.

In Naki-Ouest and Tandjouare, sorghum yields were higher compared to Timbou. In general, yield advantage of the two varieties were similar to the local check (Djeri) which is an improved variety introduced from Ghana. However, under intercropping with cowpea at Tandjouare, Sorvato 1 and 28 outyielded Djieri by 754 and 460 kg/ha respectively.

Economic study revealed that production of sorghum is overall profitable in the region. But, net revenue vary according to the sites and the cost of the input as well as the time of commercialization of the produce. In any case, the new varieties gave higher net returns than the local cultivars (**Fig. 4**). Sorvato 1 had a higher net return (171 717 to 260 467 FCFA/ha) followed by Sorvato 28 (**Table 2**) under pure cropping. Among several factors explaining this high return of Sorvato 1 and 28 is the higher price per kilo of their grain, particularly for Sorvato 1 which averages 20 fCFA per kilo more than the local checks. This is so because consummers already appreciate these varieties and are ready to pay premum for the added quality they have over the local varieties. No sensible difference in cost of production was recorded between the two improved varieties and the local checks. To sum up, the difference in return are due to two main factors: difference in yield and differences in grain price. Participating farmers showed preferences for the two varieties for their high yield performance, the taste of the local dish (To) and local beer prepared from them. These highly appreciated organoleptic quality of the two improved varieties combined with the high yield and early maturity suggest farmers will benefit

from their dissemination. Extra efforts should be made for the seed of these varieties to be available to the farmers.

Figure 4: Gross return of sorghum varieties in Northern Togo, 2000



Intercropping cowpea and sorghum is a commun practice in Northern Togo. This strategy allows the farmer to produce cereal for food and the legume for cash crop. During these trials, it was deemed necessary to compare intercropping early maturing sorghum with cowpea and sole sorghum. With the intercropping, yield of cowpea was very marginal specifically in Naki-Ouest and Tandjouare (62 to 196 kg/ha). These low cowpea yields are due to the fact that farmers leave the fields unattended after sorghum harvest, therefore, subjecting the later maturing cowpea cultivars to attack by animals. Cowpea

Table 2: **Grain yield (kg/ha) of improved sorghum varieties and cowpea in Northern Togo, 2000.**

	Timbou			Naki-Ouest			Tandjouare		
	Sole sorghum	Sorghum intercropped	Cowpea intercropped	Sole Sorghum	Sorghm Intercropped	Cowpea Intercropped	Sole Sorghum	Sorghum Intercropped	Cowpea Intercropped
Sorvato 1	3014 a	3755 a	250	3992	2703	135 a	3643	3568 a	69
Sorvato 28	2979 a	3152 a	243	3882	2883	196 a	3369	3454 a	70
Kadag	2289 b	2260 b	253	-	-	-			
Djeri				3582	2838	106 b	3340	1994 b	62

yield at Timbou was however higher (250 kg/ha), similar to the national average. The intercropping of cowpea and sorghum seems to provide additional income since there is no adverse effect on the sorghum yield. At Timbou and Naki-Ouest, net return of sole crop was lower than intercropping with cowpea. But, it is believed that this observed differences are due to the higher yield of sorghum, not the effect of the cowpea intercropped. More work is needed to investigate the comparative advantage of the sole cropping and intercropping of these varieties with the local cowpea. Most farmers believe that intercropping early maturing varieties and cowpea is difficult unless animals are parked during the whole cropping season to prevent damages to the cowpea after sorghum harvest.

Summary and recommandations

In the department of Tone and Tandjouare, on-farm verification trials of two improved early maturing sorghum varieties (Sorvato 1 and Sorvato 28) both developped by ITRA the Tologese NARS were conducted. Farmers appreciated the high yield performance of both varieties compared to the local cultivar Kadag. The tendancy was to select Sorvato 1 for making To (a local dish) and sorvato 28 for making local beer.

Recognizing that economic return is very important for the adoption of the varieties, a study was done to determine the economic return of the two varieties compared to the local cultivars. Sorvato 1 had a higher net return (171 717 to 260 467 FCFA/ha) followed by Sorvato 28 (Fig 3.) under pure cropping. Among several factors explaining this high return of Sorvato 1 and 28 is the higher price per kilo of their grain, particularly for Sorvato 1 which averages 20 fCFA per kilo more than the local checks.

The adoption of these varieties could be hampered by seed availability. Furthermore, it is recommended that effort be made for farmers to produce seeds under the supervision of ITRA and the extension service.

It is unlikely that farmers accept to intercrop the early maturing varieties with the longer maturing cowpea varieties. Furthermore, early maturing cowpea varieties should be introduced in the region.

Niger: Filling gap of food shortages

The main objective of the program is to enable farmers attain food security by accessing improved maize and cowpea production technologies. Initially, maize and cowpea cultivars that are drought and insect resistant, and early maturing, were introduced in order to fill the gap of "food short falls" before the harvest of millet, the main staple food crop in Niger.

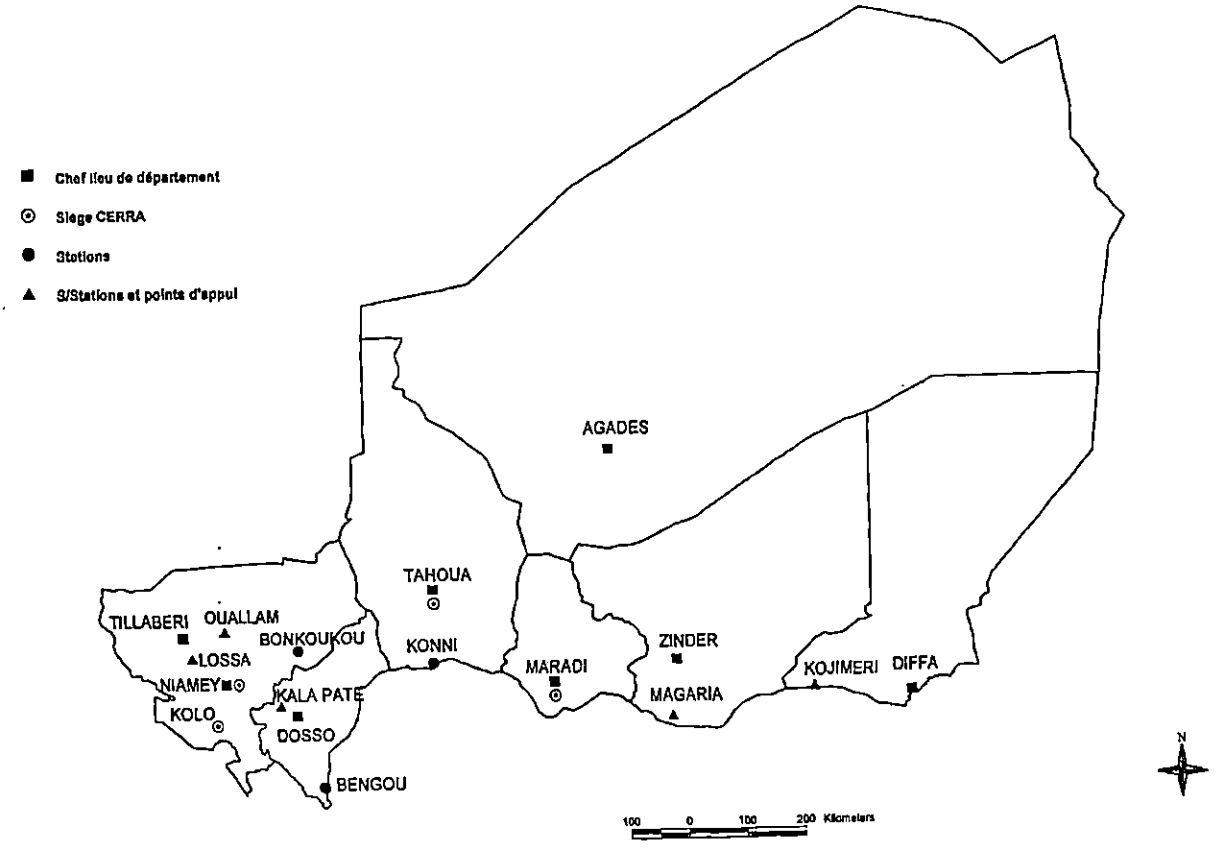


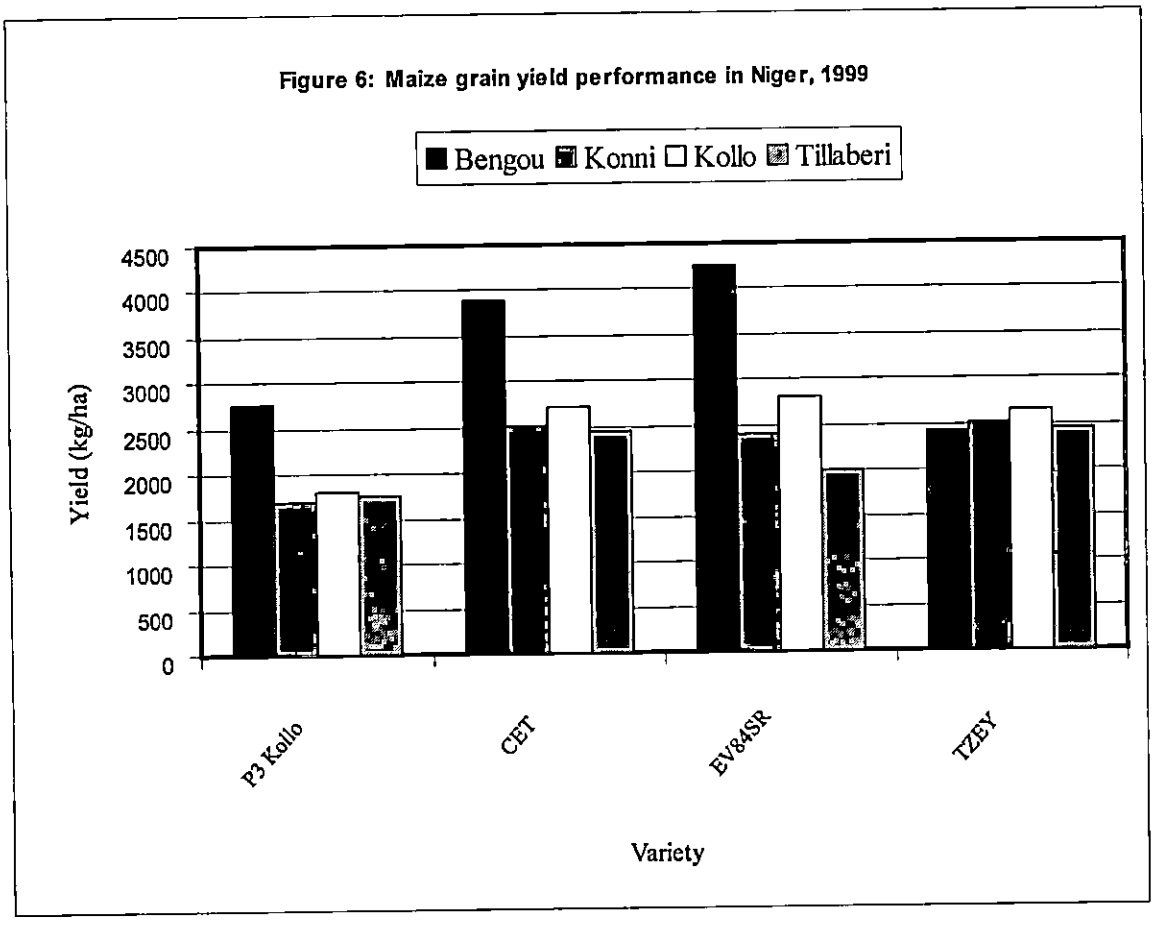
Figure 5: Project site in Niger

Maize

In 1999, four improved early and extra early varieties of maize including locally improved maturing cultivars (EV84SR EV89TZEE, TZEYSR and P3 Kollo) and agronomic practices were evaluated in Kollo, Gaya, konni, Tillaberi and Lossa by 28 farmers. These maize cultivars matured within 78 to 85 days and were used as green maize within 65 days.

In 1999, the EV84SR variety has been well appreciated especially for the number of ears per plant and its vigorous growth in addition to its very high yield in Bengou (4260 kg/ha). The TZEY variety proved to have a stable performance at all sites, especially in Bengou, Konni, and Kollo **(Fig. 6)**.

Figure 6: Maize grain yield performance in Niger, 1999



In 2000, the same varieties were demonstrated at Kollo, Konni, around Niamey, Gaya, Bengou, Tondika, and Tounga under dryland and irrigated conditions. Around Kollo

and Niamey, thirteen farmers undertook maize production under rainfall conditions at Kirkisoye, Saga Gorou, Molli, Kollo Djerma. Grain yield varied from 615 to 655 kg/ha because of persistant drought spells. At Konni, grain yield were higher, for the five farmers involved: 790 to 810 kg/ha. At Gaya, maize yields for the seven farmers involved ranged from 771 to 842 kg/ha. At all locations, yields were higher for P3 Kollo.

These improved maize cultivars were made accessible to more than 150 farmers who also visited the different on-farm trials. Seed of the five improved varieties were increased: P3 Kollo (50 kg), CET (20 kg), EV84SR (20 kg), TZEY (15 kg), and EV89TZEE (600 kg).

Early maturing maize cultivars not only generated income but also improved availability of food.

Eleven farmers undertook intensive maize production (var. TZEE, P3 Kollo, and EV 84SR) in Konni and Kollo. Farmers were also involved in both green maize and seed production. A total of 13 farmers from the two regions benefited from training in seed production and enhancement of seed purity. The two year activities revealed that the intensive production of maize under irrigation is economically feasible particularly with P3 Kollo both at Konni and around Niamey. The maize was largely harvested green for immediate sale at the rate of 5 ears for 100 F CFA, generating about 84,800 F CFA profit per ha. At the same time, 1300 kg, 450 kg and 3300 kg of seed of EV 98 TZEE, EV 84.31 SR, and P3 Kollo were produced respectively by eleven farmers in the two regions.

Cowpea

Cowpea is an important grain legume extensively cultivated in Niger as source of protein in millet and rice based diets and for its quality hay/forage to raise small ruminants in particular and livestock in general. Cowpea also provides cash income to farm households.

In 1999, on-farm demonstration trials of 3 varieties (KVX30-309-6G, IT 90K-372-1-2, TN 121-80) and local cultvar were implemented in Kollo and Konni (**Fig. 5**), involving a total of 30 farmers. IT 90K-372-1-2 is an early maturing high yielding and aphids

resistant variety developped by IITA while TN 121-80 has an intermediate cycle, is high yielding and resistant to striga and is a double purpose cowpea variety.

In 2000, in the regions of Kollo and Konni, three improved varieties of cowpea (TN121-80, IT90K-372-1-2 and local variety) and improved agronomic practices (fertilization and application of insecticide) were tested as sole crop or in association with millet. More than 100 farmers participated in these demonstration trials. Based on the farmers choice, seed of IT 90 K and TN 121 80 was produced on-farm and on-station (at Kollo, Koure, Konni, Maradi, and Tara on 14.25 ha).

In 1999, in Kollo, the improved varieties IT90K-372-1-2 and TN27-80 matured 14 to 15 days earlier than the local cultivar and produced 5 and 4 times more than the local cultivars. IT90K-372-1-2 variety has been appreciated by the producers for its earliness, high grain yield and white color seed coat. In Konni, KVX30-309-6G variety was preferred for its high grain yield and the big seed size. Highest grain yield for this variety was observed at Tierassa (1381 kg/ha) (Table 3). On the average, its grain yield was 9% higher than the local cultivar.

Seed of three varieties of cowpea has been increased in Kollo and Lossa. The total production of seed during the rainy season was 403 kg (209 kg for IT90K-372-1-2, 156 kg for KVX30-309-6G and 38 kg for TN27-80). This amount of seed is adequate to plant close to 33 ha the following season.

New high yielding cowpea cultivars has been identified and accepted by farmers.
In 2000, a total of 153 farmers of 5 farmer cooperatives conducted cowpea on-farm trials at Konni and Kollo. Grain yields were acceptable at Konni under intercropping except at Takorka (less than 100 kg/ha) and in sole cropping. IT90K372-1-2 had yield as much as 940 kg/ha at Konni which is comparable to its performance on station. Compared to the local check, yield of the IT90K372-1-2 were 133 % and 218 % higher than the local check respectively in intercropping with millet and in sole cropping. Yields were lower at Kollo in both sole and intercropping (61 to 364 kg/ha). Out of 378 farmers, who

participated in the evaluation of the varieties, from 14 villages in the Kollo region, IT90K372-1-2 was ranked first in 12 villages. In the Konni region, fewer farmers participated in both field visit and in the selection of the varieties. However, as in the Kollo region, farmers selected IT90K372-1-2 for its earliness, grain size and colour as well as high grain yield. In all villages, farmers preferred one of the improved varieties over their local cultivar. A total of 1960 kg of cowpea seed was produced on-station. Community seed production by farmers amounts to some 442 kg of seed.

Table 3: on-farm Performance of cowpea varieties in Konni, Niger, 1999

Village	KVX30-309-6G				LOCALE				TN27-80			
	50% Flowering (days)	Grain yield kg/ha	Vine yield kg/ha		50% Flowering (days)	Grain yield kg/ha	Vine yield kg/ha		50% Flowering (days)	Grain yield kg/ha	Vine yield kg/ha	
Tsernaoua	53	904	893	23	53	1410	1369	41	43	1384	1235	34
Tiérassa	40	1381	1282	28	46	962	1404	14	46	620	1151	25
Bazaga	46	714	439	-	53	317	685	-	50	670	576	-
Jiko	48	566	289	25	50	645	871	22	48	56	305	8
Toumboula	46	651	432	7	62	517	607	11	49	201	495	19
Mean	47	843	667	21	53	770	987	22	47	586	752	21

Summary and recommandations

In Niger, maize and cowpea are important source of food during period of food shortages before the harvest of millet. Agronomic and quality evaluation of cowpea varieties with the participation of farmers were carried out in 1999 and 2000.

The improved varieties IT90K-372-1-2 and TN27-80 matured 14 to 15 days earlier and produced 5 and 4 times more than the local cultivars. On the average, KVX30-309-6G grain yield was 9% higher than the local cultivar. IT90K372-1-2 yielded as much as 940 kg/ha at Konni, which is comparable to its performance on station. Compared to the local check, yield of the IT90K372-1-2 were 133 % and 218 % higher than the local check respectively in intercropping with millet and in sole cropping.

In the Konni and Kollo region, farmers selected IT90K372-1-2 for its earliness, grain size and colour as well as high grain yield. In all villages, farmers preferred one of the improved varieties over their local cultivar.

Results indicate that cowpea production can be increased at on-farm level through the diffusion and adoption of early maturing high yielding varieties combined with small amount of fertilization.

On-farm demonstration trials of three early and extra early maize varieties (P3 Kollo, EV84SR and EV89TZEE) were carried out at Kollo, Konni, Gaya, Bengou, Tondika, and Tounga. EV84 SR confirmed its high yielding performance over P3 Kollo. This variety is resistant to streak virus and yielded about 4260 kg/ha at Bengou. It is preferred by farmers for production and sale as green maize.

Intensive production of maize by farmers under irrigation proved economically feasible. Farmers can generate about 84,800 fCFA profit per ha and still produce seed for sale the next growing season.

Mauritania: Resolving problems of crop production under harsh environment

Mauritania has a very harsh environment with only 0.5% of the country having annual rainfall above 400 mm. Rainfall during year 2000 was about 393mm in the region where the trials were conducted. In the Gorgol region, irrigation is available all year long because of the Senegal river and its affluents (Black and White Gorgol) with high water reserves. Population density is about 16 per km2.

The semi-arid environment in Mauritania requires those maize and cowpea cultivars of short cycle, drought and insect resistant. Furthermore, the program was designed to test at the on-farm level, improved varieties of cowpea introduced through collaboration with other NARS.

The main objective of the program was to identify adapted varieties of maize and cowpea for dryland and irrigated growing conditions in Mauritania.

Maize

In 1999, improved maize varieties (97 TZEE-W3 C1, Kamboinse 88 Pool 16 DT, CSP-SP BC5) were compared with Maka, a local variety in both rainy and dry seasons. These activities were carried out in the region of Gorgol and Guidimakha. Grain yields were similar at both sites with an average of 1.7 t/ha. However, no significant differences were observed among variety tested. In some places, grain yields of 3 to 3.75 t/ha were recorded.

During year 2000, under rainfall conditions, at Guidimakha, 16 farmers undertook on-farm testing of early and extra early maize varieties. The varieties were comprised of 97TZE-W3C1, CSP-SR-BC5, and Makka as a local check, for the extra early group, and Kamb 88 Pool 16 DT, Early Thai for early group. Grain yields were generally low, with a maximum of 875 kg/ha at M'Bekhere to as low as 350 kg/ha in Mamayel **(Table 4)**. The trend is the same for both early and extra early varieties **(Table 5)**. These low yields

reflect the difficulties of maize production in Mauritania. Improved varieties do not yield significantly more than the local checks. A total of 167 kg of seed was produced.

Table 4: Performance of extra early maturing maize varieties in Mauritania

V arieties	M'Bekhere		Mamayel		Galala	
	50% flowering	*Grain Kg/ha*	*50% flowering*	*Grain Kg/ha*	*50% flowering*	*Grain Kg/ha*
97TEE-W3C1	45	875	45	350	47	358
CSP-SR-BC5	46	650	46	350	49	581
Makka (TL)	45	700	45	475	49	475
Mean	45	742	45	392	48	468
CV %		16%		18%		24%

Table 5: Performance of early maize varieties in Mauritania, 2000

Varieties	Galala		Mamayel	
	50% flowering	*Grain Kg/ha*	*50% flowering*	*Grain Kg/ha*
KBSE Pool 88 DT16	57	350	59	788
Early Thai	58	550	58	763
Makka Guidimakha Check	55	638	56	575
Mean	57	513	58	730
CV %		29%		16%

Cowpea

Througout the semi-arid regions of West Africa including Mauritania, cowpea is one of the main sources of protein for improving the basic diet of the poor. To assess the pest resistance and yield of cowpea, five introduced varieties from Burkina Faso and Nigeria were evaluated. The agronomic performance of these varieties was assessed at Ganky and Seynne under rainfed condition; and at R'Kiz (South of Nouakchott) and Keur Macene under irrigation.

In 1999, improved varieties of cowpea (TVX32-36, KVX61-1, IAR 7/180-5-5-1, KVX 414-22-72, KVX 414-22-2, KVX396-4-5-2D) were evaluated under rainfall and irrigated conditions in the region of Gorgol and Trarza. The same varieties were also evaluated on-station in Kaedi.

During year 2000, maize demonstration activities were realized at the sites of Fankoulou and Coumba N'Diaw involving the same varieties as in 1999 and 8 farmers. Five cowpea varieties (KVX414-22-72, KVX414-22-2, KVX396-4-5-2D, IAR 7/180-5-5-1, and Mougne) were demonstrated under dryland and irrigated conditions, involving 22 farmers at Trarza, Gorgol, Brakna, and Guidimakha.

In 1999, at Keur Macene, under irrigation, yield of maize were also very low (average of 247 kg/ha), because of salty soils. Some of the tests were relocated in this region. At R'Kiz, KVX 61-1 had the highest yield (521 kg/ha), about twice the yield of Mougne the local check. Most of the varieties tested were earlier maturing than the local check. KVX 61-1 was 2 days earlier maturing than the check. However, KVX61-1 had a mixed seed coat color and farmers tend to prefer varieties having big white seed.

At Mamayel, Galala, Ganky and Seyenne, several reseeding were necessary to obtain acceptable cowpea plant stand. Grain yields were generally low because of drought spells recorded during the production period. There was also a heavy insect attack on the plant. Nevertheless, KVX 61-1 and TVX 3236 gave the highest grain yields.

Narrowing the yield gap between on station and farmers fields

On-station cowpea adaptation trials revealed the high potential of the improved varieties. Significant differences existed among varieties for grain yield. Average yield was 1012 kg/ha. IAR 7/180-5-5-1 had the highest yield (1273 kg/ha) and KVX 414-22-2 the lowest (891 kg/ha). This suggest that tremendous amount of work need to be done at farmer level to reduce the yield gap observed between on-station and on-farm. **(Fig. 7).**

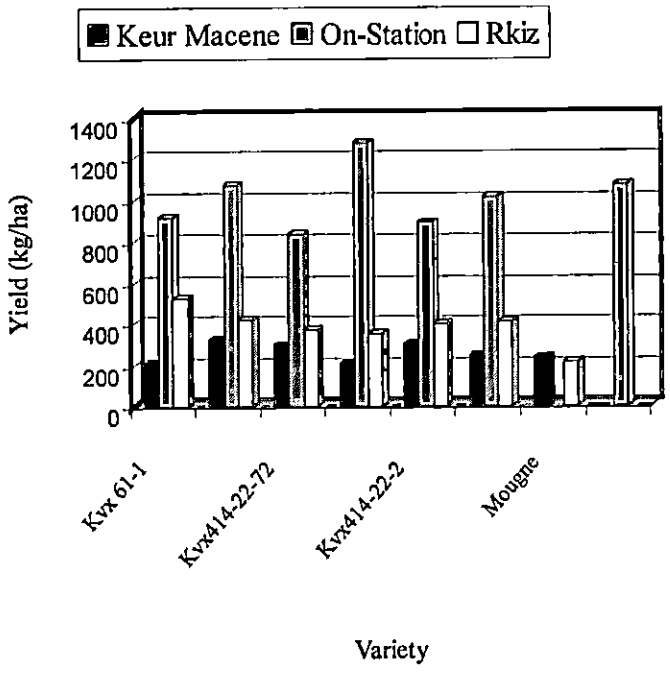
In 2000, twenty two farmers participated in the on-farm evaluation of 4 cowpea varieties under irrigation at Belinabe Lexeiba and R'Kiz. Grain yields at Belinaze were high and acceptable with a maximum of more than 1117 kg/ha for KVX 414-22-2 **(Table 6).** Some of these varieties also had a very high vine yield (for example 1800 kg/ha for KVX 414-2-2) which is appreciable for animal feeding. At Lexeiba and R'Kiz, average yield were 499 and 587 kg/ha respectively. No significant difference was observed among varieties in these two zones. In Ganki and Talhaya, under rainfall, grain yields were lower, with averages of 499 and 567 kg/ha respectively. While no significant difference was observed among varieties for grain yield at Ganki, KVX 396-4-5-2D had the highest grain yield at Talhaya (607 kg/ha). Farmers rated the varieties using a 1-5 rating scale for the following criteria: earliness, grain color, size of the grain and grain and vine yield. Their choice varied according to the sites, but, KVX 414-22-2 was very well appreciated by farmers in Belinabe and R'Kiz for high grain yield and seed quality.

In 2000, eight varieties were evaluated on-station at Kaedi in order to select the top yielding for inclusion in the on-farm evaluation the following year. The average grain yield was 800 kg/ha with a minimum and maximum of 400 and 1200 kg/ha respectively. KVX 396-4-5-2D and KVX 61-1 had the highest yields (1006 and 1152 kg/ha respectively). The local check Mougne gave the least yield (371 kg/ha) and had the longest maturity cycle.

Table 6: On-farm performance of cowpea cultivars in Mauritania 2000

Varieties	Belinabe			R'Kiz		Lexïba			Ganki		Talhaya	
	Pod yield kg/ha	Grain yield kg/ha	Fodder kg/ha	Grain yield kg/ha	Fodder kg/ha	50% Flowering (DAP)	Grain yield kg/ha	Fodder kg/ha	50% Flowering (DAP)	Grain yield kg/ha	50% Flowering (DAP)	Grain yield kg/ha
KVX414-22-2	1300	1155	1800	555	1007	432	573	638	3975	527	440	557
KVX414-22-72	1117	836	1617	580	820	438	424	632	4425	492	438	580
KVX396-4-5-2 D	967	831	1323	661	791	490	449	563	4025	480	438	607
IAR 7/180-5-5-1	1052	810	1420	629	958	468	424	660	4775	496	49,	525
Local check	750	565	1530	509	1024	568	428	550	-	-	-	-
Mean	1037	845	1538	587	920	4792	460	609	4300	499	453	567
CV%	153	149	222	271	414	12	393	23 6	55	342	15	101

Figure 7: Yield performance of cowpea varieties tested in Mauritania, 1999



Twenty extra early cowpea varieties were evaluated on-station in order to assess their adaptation to the agro-ecological conditions of Mauritania. Average grain yield was 718 kg/ha. 97K-350-4-1 had the highest grain yield of 921 kg/ha. Seven varieties were identified with grain yield superior to 800 kg/ha. They include: IT95K-1093-5, IT95K-238-3, 97K499-4, 95K-1156-3, 97K350-4-1, 98K558-1 and 98K469-11.

Data from the on-station trial shows that: i. cowpea has good potential in Mauritania; ii. yield gap between on-station and farmer field is quite large, pointing out the tremendous challenge that exists to reduce that gap; iii. Based on results at Belinabe, yield gap between on-station and on-farm can be narrowed substantially.

Summary and recommandations

To determine the adaptability of new introduced cowpea varieties on-station, two set of trials were carried out. In the early maturing variety trial, eight varieties were tested. KVX 396-4-5-2D and KVX 61-1 had the highest yields (1006 and 1152 kg/ha respectively). The local check Mougne gave the least yield (371 kg/ha) and had the longest maturity cycle. A total of 20 extra early varieties were evaluated. 97K-350-4-1 and 98K-558-1 had the highest grain yield (more than 900 kg/ha). Overall, some varieties had good agronomic value and should be tested the following season before moving them to farmer fields.

Improved maize varieties (97 TZEE-W3 C1, Kamboinse 88 Pool 16 DT, CSP-SP BC5) were compared with Maka, a local variety in both rainy and dry seasons. Average grain yields of 1.7 t/ha was recorded with a maximum of 3.75 t/ha. However, improved varieties did not significantly outperform the local checks.

Cap Verde:

In Cap verde **(Fig. 8)**, small farm holding is common due to the scarcity of arable land. Most families depend on non-agricultural revenues for their subsistance. Rainfall is highly irregular both in quantity and repartition. Predominant cropping include maize associated with cowpea and irrigated production. Animal production is also practiced. The objective of the program in Cap-Verde was to compare at on-farm level, the performance of selected or introduced crop varieties including maize, pigeon-pea and groundnut. In addition pure cropping of cowpea was evaluated in comparison with traditional intercropping of cowpea, maize and *Dolichos lablab*.

Rainfall on the site varied from 512 to 764 mm during 4 to 5 rainy months during 2000.

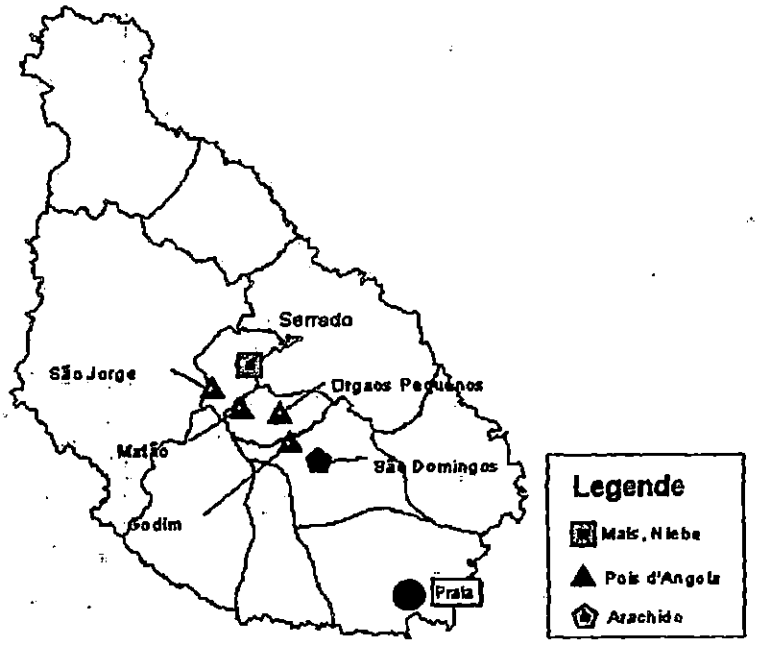


Figure 8: Map of Cap Verde showing trials sites

On-farm evaluation of maize varieties (Maka against local varieties) was undertaken at Achada Lem, Achada Falcao with 4 farmers. Maka had a better yield (1938 kg/ha) than the local check (1563 kg/ha), although no signficant difference was observed.

Sole cowpea production system is compared with cowpea grown in association with maize and *Dolichos lablab* in two farms at Serrado. The yield response of the local cowpea variety to pure cropping is positive. Yield of pure cropping of cowpea was 14 time more than the traditional method of intercropping cowpea with maize.

A variety of pigeon pea from ICRISAT (ICPL 187) was compared with three local landraces (Fogo, Santiago, São Nicolau) by 8 farmers, at Sao Jorge, Matao, Godim, and Orgaos Pequeno. Local land races of pigeon pea had a better plant development compared to new ecotype (ICPL 187). High mortality rate was observed with the new ecotype since it was left for over 8 months exploiting only the residual soil moisture. The performance evaluation is mainly based on phonological development, where often local land races strive much better. A major constraint is the survival rate for the new

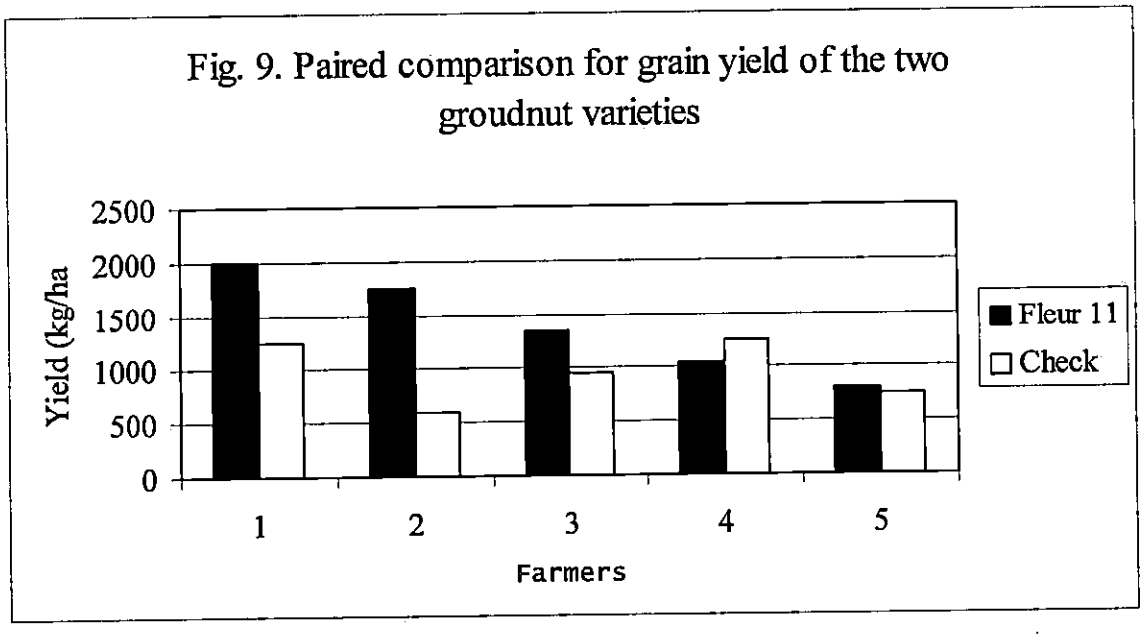
cultivar. Since plants were left for over 8 months, exploiting only the residual soil moisture and considering the plant size (root system), a high mortality rate is expected for ICRISAT cultivar. Production cycle usually begins the second year for this perennial crop. Consequently, yields data will be analysed when available.

Five farmers evaluated an improved introduced groundnut chinese variety, Fleur 11 against the local variety at Orgaos. Fleur 11 and the local variety were characterized **(Table 7)** and Fleur 11 was found to be acceptable for production in cape Verde. It had a more uniform and higher germination rate than the local variety. Its maturity cycle was shorter (90 days) and the yield significantly higher than the local cultivar. **(Fig. 9).** The earliness of Fleur 11 allowed the escape of the end of season drought, although under normal conditions, the local variety is more drough tolerant than Fleur 11. For grain yield, the overall mean was 966 kg/ha, while that of Fleur 11 was 1408 kg/ha and the local variety yielded 994 kg/ha. The graphic in **Figure 9** shows the grain yield for all plots in the 5 benefiting farmers. Considering only the plots located on flat land (3 farmers), Fleur 11 outperformed the local variety by about 45%, but there was no significant grain yield difference between the two varieties on the plots located on the hillsides (2 farmers). The highest pod yield observed for Fleur 11 on-farm was 2000 kg/ha, below its performance on-station trials (2600 kg/ha). In addition, shelling percentage of Fleur11 was 78% compared to the local variety (62%). These results suggest that Fleur 11, which has already been released in neigboring Senegal, is promising for the growing conditions of Cap Verde and should be tested before recommending its release. Since groundnut is a cash crop, mainly commercialized by woman, the income will help them with the household expenses, therefore, contributing to the improvement of their livelihood.

Table 7 : Characteristics of Groundnut varieties during vegetative phase and after harvest

Varieties	Origin	50% germination (days)	50% Flowering (days)	Maturation (days)	Growth Habit	Plant color
Fleur 11	CORAF peanut network (GGP)	10	25	90	Tall, erect	Light green
Local	Santiago	15	33	110-115	Short, erect	Dark green

Varieties	# seeds/pod	Weight of 100 seeds (g)	Seed size (#seed/oz)	Form of Seed	Seed color	Form of pod (separation of cavities)
Fleur 11	2	62	47 (Viginia medium)	Oblong	Light pink	Medium
Local	2	58	53 (Virginia medium)	Oblong w/beak	Pink	Strong



Summary and recommendations

On-farm evaluation of maize varieties (Maka against local varieties) was undertaken at Achada Lem and Achada Falcao with 4 farmers. Maka had a better yield (1938 kg/ha) than the local check (1563 kg/ha), although no signficant difference was observed. Since Maka is a local cultivar from Mauritania, the results suggest that it has the potential for being improved through breeding for higher yield under the agro-ecological conditions of Cap-Verde.

Yield of pure cropping of cowpea was 14 times more than the traditional method of intercropping cowpea with maize. Therefore, this cropping system should be promoted at farmer level.

Fleur 11, an introduced groundnut variety was compared with the local variety. For grain yield, the general mean was 966 kg/ha, while that of Fleur 11 and the local cultivars were 1408 kg/ha and 994 kg/ha, respectively. On plots located on flat land, the new variety outperformed the local one by about 45%.

The out-performance of Fleur 11 relatively to the local variety is mainly due to its shorter maturation cycle, which allows grain yield even under a short rainy season and a better shelling percentage. Farmers were impressed with the performance of the new variety and expressed interest to try it on their own if seed is available.

To consolidate these results and for better accuracy, the trials should be repeated with a larger number of farmers (beneficiaries) at a more wide range of agro - climatological conditions. Plot size should also be larger (at least 100 m^2) if seed is available. An economic impact study and a survey to assess farmers and consumers opinion should also be conducted to evaluate the socio-economic feasibility of Fleur 11.

Benin:

Constraints to food grain production in Northern Benin are poor soil fertility, lack of improved seed, pests and disease. Rainfall is irregular, with annual average of less than 900 mm. Cash crops such as cotton benefit from a well developed credit system to facilitate access to inputs. This is not the case for cereals. Furthermore, farmers have high preference for cotton production.

The main cultivated crops in Northern Benin include maize, sorghum, millet, yam, cotton, cassava, groundnut, and cowpea. Field trials were carried out at Ina, Angaradebou, Thui, Bagou and Sokka, in northern Benin. Due to seed limitations, trials were undertaken for maize and cowpea in the first year.

On-farm participatory evaluation of improved maize varieties were carried out at Bagou and Angaradebou. The QPM variety (Faaba), (**Figure 10**) TZEE-SR, and a local check (the farmer variety) were compared in 19 farmers fields. As indicated in **Table 8,** yields of Faaba (2647 kg/ha) was superior to the farmer check (1076 kg/ha) at Bagou. Maize

Figure 10: Scientists in a maize plot (Faaba) in Benin

yields were higher at Angaradebou: 2429 kg/ha and 2166 kg/ha respectively for Faaba and the farmer check. Farmers were favorably impressed by the performance of Faaba and there is high demand for seeds of this variety.

Cowpea verification trials consisted of IT95K-193-12, IT95K-362-7, and a local variety in Sokka **(Figure 11)**. At Angaradebou sites, IT97K-499-39, IT89KD-349, and IT95K-627-34 and a local variety were tested. A total of 10 farmers conducted the on-farm cowpea varietal trials. Whenever possible, the same farmers were selected to implement both maize and cowpea trials.

Figure 11: On-farm cowpea plots in Sokka, Benin

Higher grain yields for cowpea were reported at Sokka (1638-1938 kg/ha) than at Angaradebou (616-1200 kg/ha) **(Table 9)**. In all cases, the introduced varieties had better yield than the farmer's check. The high yield in Sokka could be due to the longer maturing varieties used at that site. At angaradebou, farmers selected IT97K-449-39

while at Sokka, IT95-193-12 was selected. Farmers selection of the varieties was based on agronomic as well as palatability criteria and did not necessarily coincide with the highest yielding variety.

Amount of seed produced will allow full implementation of the trials for next year.
The following crop varieties seeds were increased:
Groundnut varieties, ICGV-SM-86028 (29 kg), EH 303-4 (28 kg), ICGV-SM 85045 (5 kg) EH 33-35 (13 kg) and CN 115 BS (7 kg); cowpea varieties, IT 97K-499-39 (32.5 kg), IT 95K-627-34 (39.3 kg), IT 95K-193-12 (39.5 kg), IT 95K-362-7 (2 kg), IT 89KD-349 (12.4 kg). In addition, ninety-five (95) kg of seed were produced for each of the two maize varieties: TZEE-SR and Faaba (QPM).

Table 8 : Performance of maize varieties evaluated in different locations in Benin, 2000

Varieties	BAGOU			ANGARADEBOU		
	50% Tasseling (DAP)	50% Silking (DAP)	Grain yield (kg/ha)	50% Tasseling (DAP)	50% Silking (DAP)	Grain yield (kg/ha)
TZEE-SRW	44.64	48.64	1449	49.1	56.0	1857
FAABA (QPM)	54.73	58.27	2647	64.0	71.9	2429
Farmer check	55.73	59.00	1076	59.9	67.3	2166
Mean	51.70	55.30	1724	57.7	65	2150
LSD	17.1	20.77	203	79.7	75.5	-
CV (%)	38	42	132	11.9	10.0	232

Table 9 : On-farm participative performance of cowpea varieties in different localities in Benin, 2000.

Varieties	ANGARADEBOU				SOKKA			
	50% Flowering (DAP)	Days to maturity	Pod yield (kg/ha)	Grain Yield (kg/ha)	50% Flowering (DAP)	Days to maturity	Pod yield (kg/ha)	Grain Yield (kg/ha)
IT 95K-362-7	46.00	72.0	1578	1140	52.4	66.80	2650	1938
IT 89KD-349	45.20	71.2	1675	1200	52.8	68.20	2175	1638
IT 97K-449-39	41.00	66.6	1365	900	52	65.40	3000	2188
Local Paysan	50.80	79.2	938	616	56	73.60	2488	1850
Mean	45.75	72.2	1389	964	53.30	68.50	2578	1903
LSD (5%)	6.014	7.44	499.7	387.1	-	5.59	-	-
CV%	9.5	7.5	26.1	29.1	7	5.90	33.3	37,2

Summary and Recommendations

Lack of seed hampered the full establishment of the on-farm verification trials in Benin for 2000. Amount of seed produced should be able to solve the problem the coming season.

Across the two sites of Bagou and Angaradebou, yield of Faaba, the QPM maize variety was higher (by 12-146%) compared to the local check which is also an improved variety. Farmers were impressed by the performance of Faaba and requested seed for the coming season.

Cowpea varieties trials were carried out at Sokka and Angaradebou. Much higher grain yields for cowpea were reported at Sokka (1638-1938 kg/ha) than at Angaradebou (616-1200 kg/ha). In all cases, the introduced varieties had better yield than the farmer's check. Overall, farmers preferred the improved cowpea varieties as compared to their local check which was always ranked last. At angaradebou, farmers selected IT97K-449-39 while at Sokka, IT95-193-12 was selected.

B. On-Farm Resource Management

Nigeria: Cereals-legume crop rotation integrated with small ruminant production in the north west zone of Nigeria

Agriculture is the main activity of most Nigerian who depend on it for their livelihood. Most of the agricultural producers live in rural areas and have little access to credit and input as well as improved technology for the increase of their production. Traditionally, these farmers integrate livestock and agricultural production, therefore being able to recycle parts of the soil nutrients. Recent population pressure has contributed to break up of this balance and today, farms sizes are dwindling to an average of less than 4 ha per household. In addition, land tenure and lack of credit make it incensitive to investing in long term soil fertility management. Intercropping or mixed cropping cereals and nitrogen fixing legumes has been shown to be an alternative to soil fertility management. Mixed cropping is particularly practiced traditionnally in Nigeria and most of West and Central Africa. One of the problem with intercropping is the determination of the optimum plant density in order to reduce competition between the two crops and to maximize production. Research activities conducted at IAR has shown that the alternate row spacing arrangement is more productive than the alternate stand arrangement practiced by the farmers. It was also found that while feeding sorghum leaves to livestock is common among farmers, the timing of the defoliation of the sorghum is known to induce significant grain yield reduction.

This project aims at demonstrating at farmer level food grains production technology integrated with livestock production through small ruminant fattening in order to improve soil fertility, enhance sustainability of the production system, and farmer income.

The technology package consist of improved agronomic practices in term of cereal/legume rotation and/or association, improved varieties of sorghum, millet,

groundnut and cowpea; the production and use of compost; animal fattening practices (improved goats and sheep feeding rations composed of sorghum leaves, legumes such as groundnut and cowpea, veterinary services, improved housing).

Two states were slected to undertake this activity:
In Katsina state (Sudano-Sahelian region) – millet variety SOSAT 88 was grown in rotation with cowpea variety IT96D 757-SR. Twelve farmers were selected based on expressed interest in the activities and also land and labor availability. The farmers also dispose of 12-15 heads of sheeps/goats per household for the small ruminant integration component. This activity consisted of supplementing the small ruminant feed in the evening using hay produced by the cowpea. The farmers were selected from 4 villages around Katsina.

In Kano state (Sudano-Sahelian region) – sorghum variety ICSV 111 was produced in rotation with groundnut var Ex-Dakar. A total of 10 farmers from two villages were selected for the activities. Crop production was integrated with sheep/goat production (12-15 heads per household). Each farm size is about 0.25 ha.

Data on soil fertility change at the beginning and end of season, crop, animal, and socioeconomic data were collected and analysed.

Annual rainfall for 2000 was 805 and 625 mm in Kano and Katsina respectively. Grain yields were lower than expected on farmer field both in Kano and Katsina states. In Kano, highest sorghum grain yield was 1283 kg/ha **(Figures 12 and 13)** . The highest groundnut pod yield was 673 kg/ha. In general, there is a high variability in yield among farmers, an indication of the differences in practices. In Katsina, lower yields were due to severe drougth conditions particularly in September and October when only 48 and 35 mm were received respectively.

Lower yield will affect the amount of stover available for the small ruminant feeding trial. However, this feeding is on-going and farmers built improved housing for

the animals. veterinary services are provided. Initial estimate is that animals are gaining weight rather faster compared to traditionally feed animals. At the same time the amount of manure produced is appreciable and will be used for soil fertilization.

Figure 12: Grain Yield performance of sorghum and groundnut under crop rotation in Kano state, Nigeria, 2000

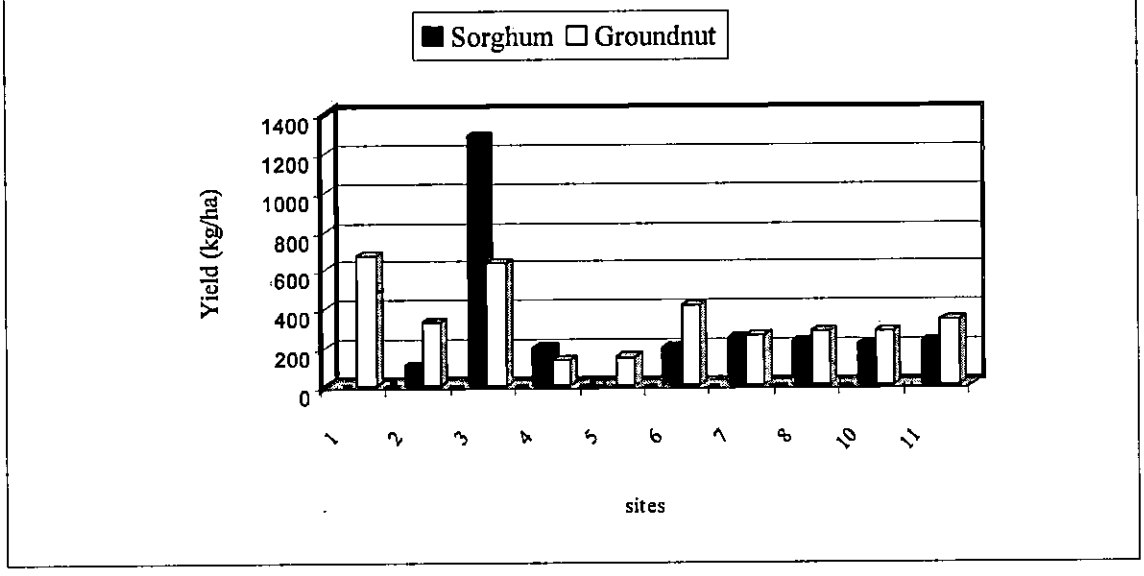
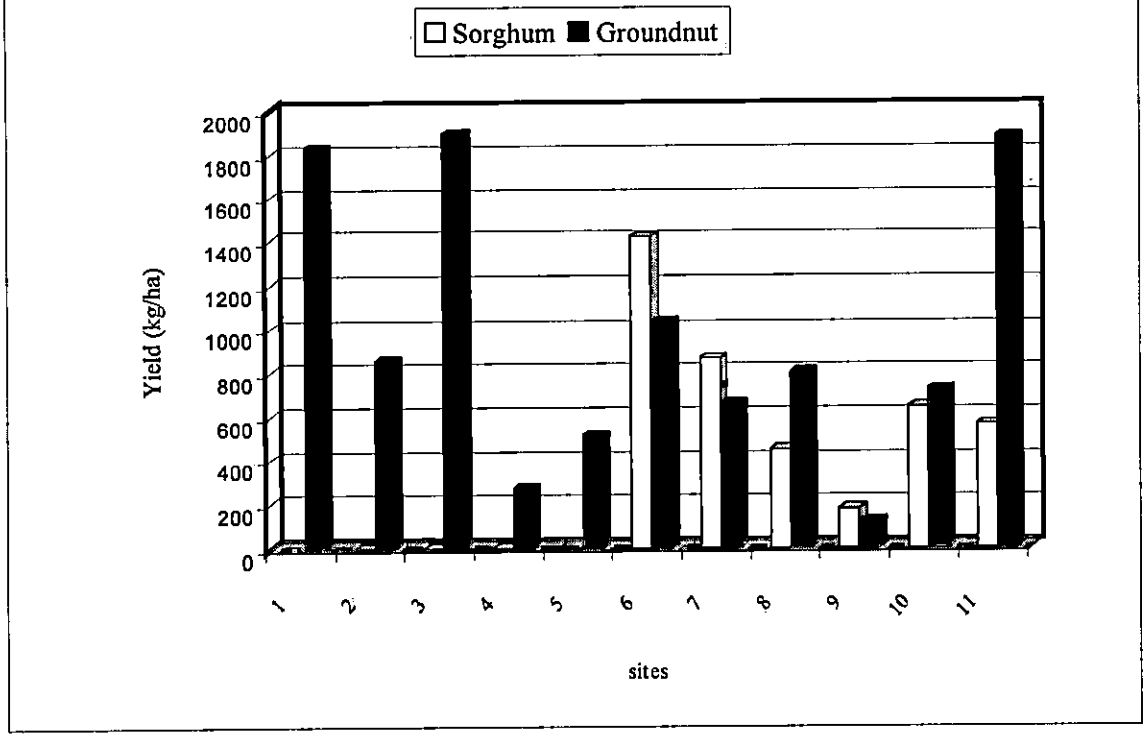


Figure 13: Fodder yield performance of sorghum and groundnut under crop rotation in Kano state, Nigeria, 2000



Summary and recommandations

In Kano, highest sorghum grain yield was 1283 kg/ha. The highest groundnut pod yield was 673 kg/ha. In general, there is a high variability in yield among farmers, an indication of the differences in practices and soil variability. In Katsina, lower yields were due to severe drougth conditions particularly in September and October when only 48 and 35 mm were received respectively.

Ghana: Agricultural intensification in northern Ghana: the influence of crop-livestock integration and composting on maize-groundnut cropping system

Northern Ghana has been termed as the bread basket of Ghana. Maize production is well adopted as it represents the bulk of the cereal consumption in the country. The removal of subsidies and the following price hick on fertilizers render maize production very difficult in this environment. In addition, while animal production is practiced, the free ranging nature of this activity renders the by -products such as manure non available for cereal production. Decline in soil fertility and subsequent crop yield decrease is the trend observed at this point in time. Problems faced by farmers with small ruminants rearing include dry season feeding, housing **(Fig. 14)**, animal health problems during the rainy season, and high livestock mortality rate. By parking animals, theft is reduced and so are the conflicts in the community over ownership of the animals.

The objectives of the program in Ghana were to improve food security through crop-livestock integration and soil nutrient recycling. Specifically, the program is aimed to:
- Improve maize yield and minimize its production cost;

- Improve soil productivity
- Promote proper agronomic practices through crop rotation and intercropping
- Promote small ruminant production and composting

- Examine the socio-economic feasibility of the proposed intervention in the zone.

Figure 14: Traditional animal housing in Norhtern Ghana

Alternative rates of fertilization for maize production

In light of the poor soils in Northern Ghana and the high cost of fertilizers, it was deemed necessary to determine at on-farm, the minimum level of manure, compost and/or chemical fertilizer required for maize production.

The activity was implemented in two agroecological zones: Northern and Upper East Regions.

Farmer variety was produced under alternative fertilization rate, use of compost, and /or crop rotation. In the Northern Region, seven farmers in Tindang and eight in Kwadushegu farming comunities were involved in comparing alternatives maize production techniques: Sole maize with compost + 30kg N for continuous cropping;

rotational sole maize with compost +30kg N; Rotational sole groundnut + 40 Kg P2O5; Sole maize with full rate fertilizer (60 kg N/ha) for continuous cropping; and Sole maize with half rate fertilizer (30 kg N/ha) for continuous cropping.

Similar treatments were tested with 13 farmers in the village of Bindure, Upper East Region with the exception that intercropping maize and groundnut was used instead of rotation, and that the half rate of fertilizer (30 kg N/ha) also received some manure.
Data on soil fertility change at the beginning and end of season, maize yield performance, and socioeconomic data were collected and analysed.

Higher maize grain yield was recorded at Tindang (1.9-2.7 t/ha) compared to Kuduziegu (0.6-0.9 t/ha). In this site, treatments with farm yard manure had better yields than those with mineral fertilizers. Treatment with half the recommended rate of fertilizer had a similar yield than the treatment with full rate of fertilizer. In the Bindure site, maize grain yield varied from 640 to 1133 kg per ha. **(Table 10)** The highest yield was observed in plots which received half rate mineral fertilizer and 6 t/ha of cowdung.

Economic analysis of the different soil fertility management practices in Bindure reveals that the highest net return per hectare resulted from the maize /groundnut intercrop, followed by half the recommended mineral fertilizer combined with 6t/ha of manure **(Table 11)**. However, the high cost of the later technology makes it less affordable to farmers. In the second year, it can be confirmed that the intercropping is the most economical alternative in Bindure.

Farmer perception of the alternative practice was very positive. In fact, at Bindure, most farmers realized that the plots with combined application of organic and inorganic fertilizer had less striga compared to those without manure. In the Northern region where higher rainfall is recorded, farmers had a very positive appreciation of the maize plots which received manure treatment because maize had greener leaves and the limbs were largers compared to only mineral fertilizer plots.

Table 10: Maize yield on participating farmer plots in Bindure, Ghana, 2000

Treatment	Maize yield (kg/ha)	Groundnut yield Kg/ha
Fertilizer + manure	1133	
Maize + groundnut	640	510
Maize + half dose NPK	737	
Maize + Full dose NPK	928	
Mean	859.5	
LSD	248	

Table 11: Partial Budgets for Different Soil Fertility management Practices

	Treatments			
	T1	T2	T3	T4
Benefits				
Grain yield of maize (kg/ha.)	1133	737	928	640
Yield of groundnuts (kg/ha.)	-	-	-	510
Income (¢/ha.)				
Maize grain at ¢1200/kg	1359600	884400	1113600	768000
Groundnut grain at ¢3000/kg	-	-	-	1530000
Gross income	1359600	884400	1113600	2298000
Labour input (Md/ha.)				
Fertilizer application	3	3	6	3
Manure application	5.58	-	-	-
Planting of maize	5.6	5.6	5.6	5.6
Planting of groundnuts	-	-	-	7.5
Total labour input	14.18	8.6	11.6	16.1
Variable costs (¢/ha)				
Cost of harvesting maize	67980	44220	55680	76800
Cost of harvesting groundnuts	-	-	-	154560
Fertilizers	275000	275000	550000	275000
Manure at ¢28000/ton	168000	-	-	-
Labour at 3000/Md	18210	25800	34800	48300
Maize seed at ¢2500/kg	56250	56250	56250	56250
Groundnut seed at ¢4500/kg	-	-	-	198000
Total variable cost (TVC)	609770	401270	696730	723050
Net Returns (¢/ha)	749830	483130	416870	1574950
Net Returns (¢/Md)	52879.41	56177.91	35937.07	97822.98

Fertilizer Prices. Compound (NPK):- ¢80,000 per bag of 50kg, Sulphate of ammonia (S/A):- ¢60,000 per bag of 50kg

Labour for harvesting. Maize:- 0.02md/kg, Groundnuts:- 0.07md/kg

They also observed that plants on this plot(T1) had bigger cobs with the plants looking more vigorous in growth than the others.

Integrating small ruminant and agriculture: Alternative to the traditional methods

As traditionally practiced, animal rearing through free ranging does not provide manure for the crops as it is very difficult to collect the manure. Furthermore, parking animals and providing supplemental feeding is an alternative that can make the manure available to the farmers. The farmers at Tindang and Kuduziegu received training in making compost, and improved animal rearing techniques (improved housing, veterinary services and supplemental feeding using cassava leaves and peels, cajanus cajun, groundnut vine, maize stover, and rice straw). The crop residue were treated with urea (1 kg urea/25 kg stover) for a period of seven days before feeding it to the previously dewormed ruminants. Each farmer had about 10 sheep or goats in the trial. The groundnut haulms was used to supplement by giving 200 g/day to each animal. Adequate water and salt lick was provided to the animals for adequate growth and reproduction. Housing and hygiene follow the recommendations by MoFA.

Nine farmers conducted animal feeding trials in Tindang and Kuduziegu. On a total of 82 sheep, which were dewormed and provided improved housing and veterinary services, Average Daily weight Gain (ADG) ranged from 35 g to 72.1 g per animal.

Summary and recommandations

In Tindang and Kuduziegu, treatments with farm yard manure had better yields than those with mineral fertilizers. Treatment with half the recommended rate of fertilizer had a similar yield than the treatment with full rate of fertilizer. In the Bindure site, maize grain yield varied from 640 to 1133 kg per ha. The highest yield was observed in plots which received half rate mineral fertilizer and 6 t/ha of cowdung.

Economic analysis of the different soil fertility management practices in Bindure reveals that the highest net return per hectare resulted from the maize /groundnut intercrop, followed by half the recommended mineral fertilizer combined with 6t/ha of manure. However, the high cost of the later technology makes it less affordable to farmers. In the

second year, it can be confirmed that the intercropping is the most economical alternative in Bindure.

Farmer perception of the alternative practice was very positive. In fact, at Bindure, most farmers realized that the plots with combined application of organic and inorganic fertilizer had less striga compared to those without manure. In the Northern region where higher rainfall is recorded, farmers had a very positive appreciation of the maize plots which received manure treatment because maize had greener leaves and the limbs were larger compared to only mineral fertilizer plots.

Nine farmers conducted animal feeding trials in Tindang and Kuduziegu. On a total of 82 sheep, which were dewormed and provided improved housing and veterinary services, Average Daily weight Gain (ADG) ranged from 35 g to 72.1 g per animal.

Senegal: Improvement of agricultural production and farmer income diversification through maize production and sheep rearing in Middle and Higher Casamance

The Middle and Higher Casamance region in Senegal has enormous natural potentialities. Main activities are agriculture and livestock rearing which are extensive in nature and very low in productivity. Today, high demographic pressure combined with inadequate agricultural practices have contributed to the degradation of the environment, and low soil organic matter and nutrients contents. On-going work on integration of cereal and forage legume such as cowpea, dolic and the rearing of goats in three villages in the region has shown positive results in terms of mitigating the soil degradation while improving production.

The Senegalese Institute for Agricultural Research (ISRA) is proposing the transfer of these technologies to 6 villages (1 household per village) in the region with the following objectives: to increase maize yield while improving the soil organic matter and nutrient content; to increase the productivity of sheep rearing through feeding supplement during the dry season with cowpea fodder, improvement of their shed and their health and

hygiene; to assess the economic impact of these new technology packages on the livelihood of farmers.

Effect of maize and cowpea production on husbandry and soil nutrient management

Maize variety JDB and cowpea variety 58-74 were tested on-farm in order to determine the effect of cowpea on maize yield and soil nitrogen content. Additionally, cowpea and maize residue's potential as fodder for animal feeding was assessed. An area of 1 ha was used and individual plot size was about 2500 m2. Twenty subplots of 16 m2 were sampled for yield determination. Soil samples were also collected at the start and end of season.

A good rainfall distribution was observed at Kolda in the 2000 rainy season with a total of 1112 mm. Maize grain yield was over the regional average yield (1000 kg/ha) in more than half of the farms. Differences in yield among farmers were due to soil fertility levels, and management practices of the farmers. Dry matter of cowpea var 58-74 under research condition varies between 5 and 5.8 t/ha. The highest cowpea dry matter harvested in the farming plots was 4.9 t/ha. In most farms, the reported dry matter yield is lower, suggesting the need for improved practice for cowpea production as well as farmer training. Nevertheless, farmers were able to store enough cowpea fodder for the small ruminant feeding trial **(Fig. 15).**

Figure 15: Improved shed for animal shelter and storage of fodder

Effect of small ruminant manure on soil improvement

The separate effect of compost and Djallonke sheep manure on the yield of maize and the soil nutriment content will be assessed. This on-going activity will consist of making compost using maize and other crop residues, and collecting small ruminant manure. Soil, manure, and compost will be chemically characterized before application on the plots. Individual plots size of 625 m2 will be used and maize yield will be estimated using subsamples of 5 subplots of 16 m2 each. Soil chemical characteristics will be monitored.

Effect of improved rearing techniques on small ruminant production and soil fertility management.

In the region of Kolda, animal rearing is very common. Farmer favor this activity because it generates income at low cost and can be practiced all year long. Beside, animals represent a capital that can be easily sold to solve family problems such as those pertaining to health, school fees or traditional ceremonies. In general, most farmers associate crop production and animal rearing. To improve food security and soil nutrient cycling, the effect of improved sheep husbandry (improved housing, veterinary services,

supplemental feeding with cowpea fodder) on productivity of Djallonke sheep was assessed. The expectation is that farmers will increase animal productivity, therefore, generate more income, while byproducts of animal production will go towards improving soil fertility. This activity is on-going. Each farmer will use 20 sheep for the activity. Animals will be dewormed and receive additional fodder in the morning before they are left out for grazing. Improved shed using local material have been constructed **(Fig. 16)**. Veterinary services are also provided. The animal performance will be measure periodically and the average weight gain per day will be determined compared to the animal subjected to traditional husbandry.

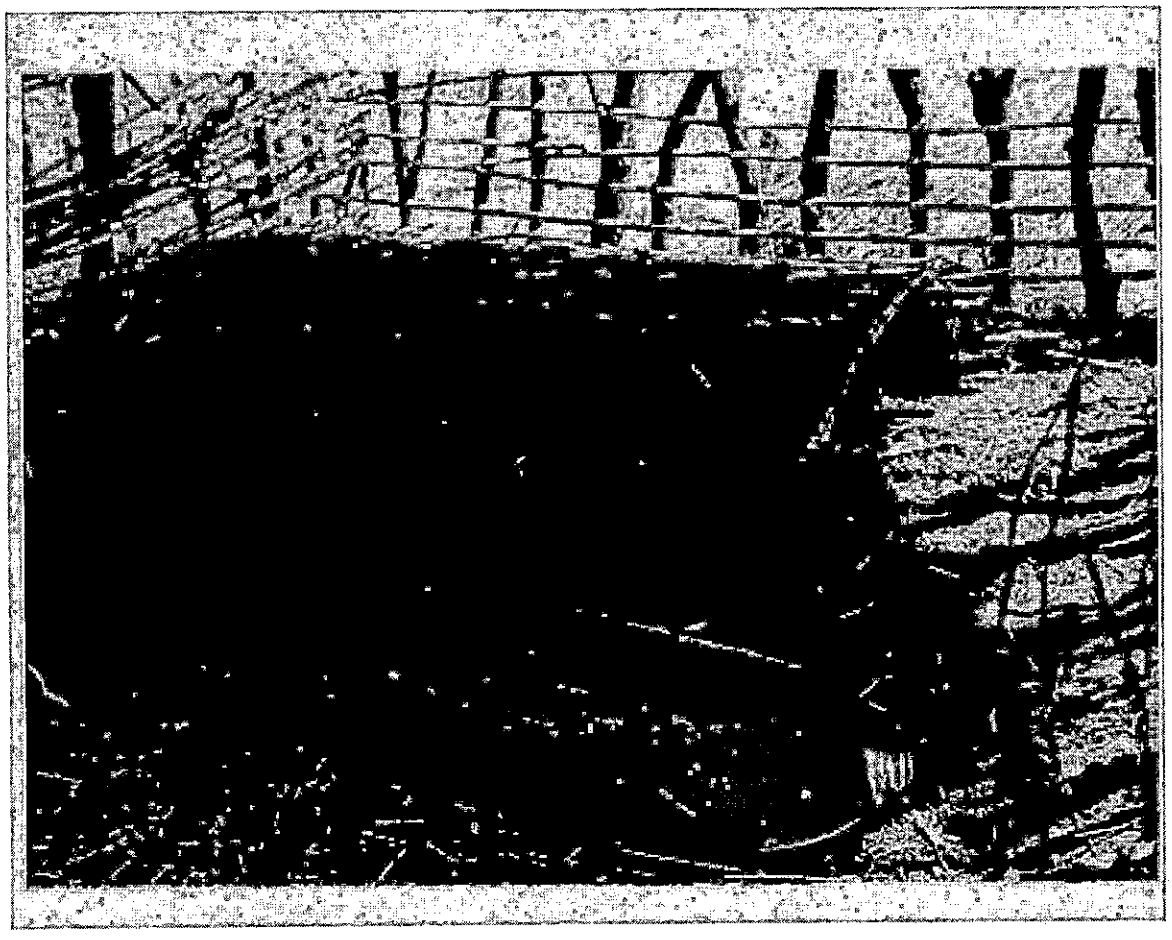


Figure 16: Feeding through using local material in Kolda, Senegal

Determination of economic impact of the technology package through interview and determination of cost of production.

This activity will be undertaken from May 2000 to April 2002. Mostly, it will use market and households surveys and the determination of impact of the technology package that was introduced.

Summary and recommandations

Maize grain yield was higher than local average yield (1000 kg/ha) in more than half of the farms. Differences in yield among farmers was due to the soil fertility levels, and management practices of the farmers. Percent dry matter of cowpea var 58-74 under research condition varies between 5 and 5.8 t/ha. The highest dy matter of cowpea harvested in the farming plots was 4.9 t/ha.

Cameroon: Integrated Striga Control Project

Striga infestation has been a major biological impediment for increasing food production in order to attain food security in semi-arid regions of Sub-Saharan Africa. About 2/3 of the African crop land sown to maize is infested, causing losses approaching 7 billions $US annually. Complete crop loss due to striga has been reported particularly in the sahelian and savanna zones where the greatest damage occurs **(Figure 17).** Host plant resistance, cultural practices, strap crops are among the methods used for controlling the pest.

As pointed out by Ramaiah et al. (1983), striga is not considered to be as important of an agricultural pest as it really is. Consequently, research for the control of striga has been neglected, if not lacking of the synergic collaboration at the regional and/or continental level.

Because of funds limitation to undertake striga research and control, this study has been limited to Cameroon which has the research and technological comparative advantage. Results of striga control trials will be shared with other countries.

The objectives of this study are: to demonstrate at on-farm level, the effectiveness of maize varieties for resistance/tolerance to striga and to promote their adoption; and to

evaluate and promote integrated striga management strategies for the reduction of soil striga seed bank and improve soil fertility.

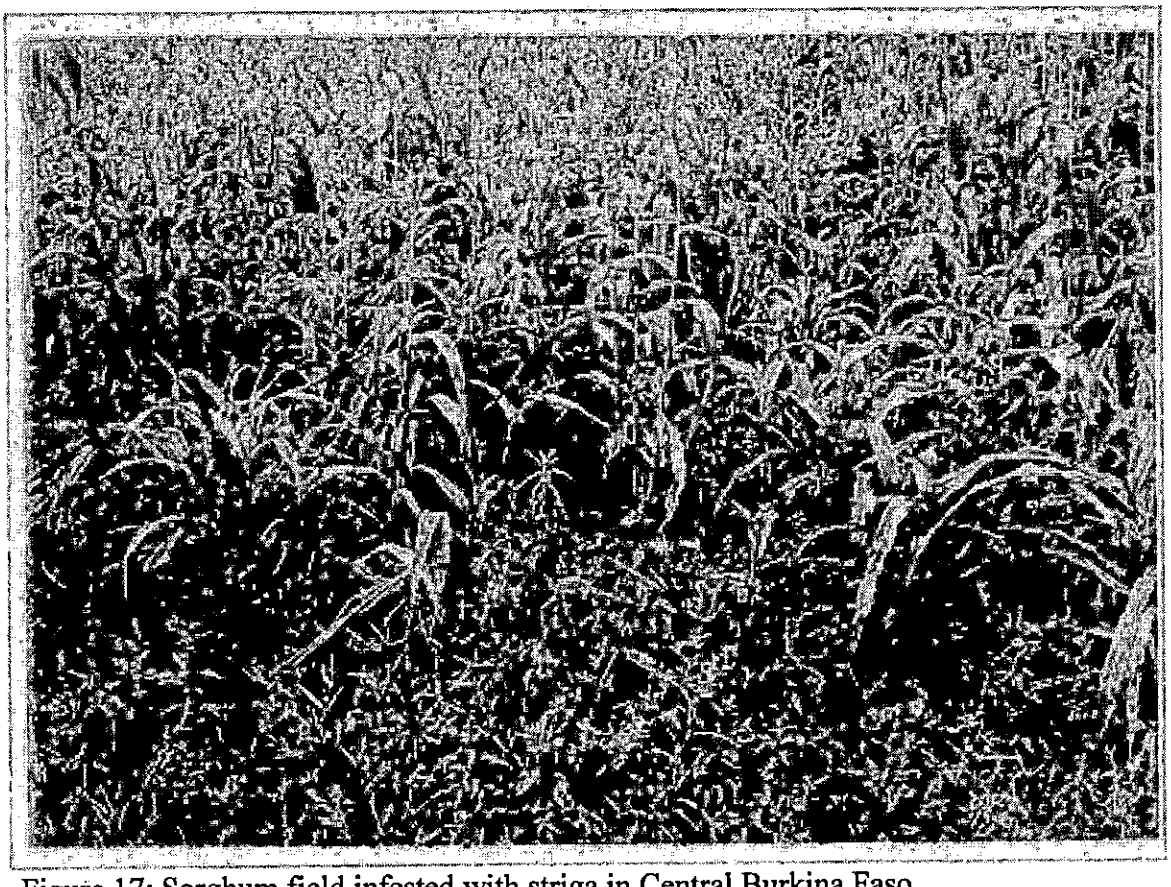


Figure 17: Sorghum field infested with striga in Central Burkina Faso

Striga resistant/tolerant maize variety trials

Fourteen maize variety trials were conducted at Maroua and Garoua. Each trial included 7 resistants maize variety and 1 local check. Cam Inb STR1 had a 30% reduction in striga infestation and a 52% grain yield increase compared to the local check CMS 8501. In general, the experimental lines had better yield and less striga infestation than the local checks. These results indicate that the use of tolerant/resistant maize varieties in striga control is promissing.

Seed multiplication of promising striga resistant maize varieties, Advanved NCRE, K9351, Syn E1, and Super Oba 1 was undertaken.

Maize/legume intercropping to control striga

Thirteen Maize/legume intercropping trials were implemented. In the maize /legume intercropping, the additional cowpea grain obtained made this practice more attractive to farmers. When STR-maize was planted on plot previously cropped to a leguminous striga trap crop, the number of striga plant emerged was generally lower than that of plots where maize/legume were intercropped for 2 consecutive years in terms of maize yield in the Sudan and Northern Guinea Savanna of Cameroon **(Table 12).** Nevertheless, the striga count is numerically lower in the maize/cowpea intercropping than in the maize-cowpea rotation. Reduction of maize yield in the intercropping plots is compensated by the additional cowpea grain. That made the treatment very attractive to farmers. This suggests that both treatments (rotation and intercropping with trap crops) would be effective in Northern Cameroon.

Table 12: Performance of alternative striga control measure under national striga infestation in Cameroon, 2000

Zone	Treatments	Maize Grain yield kg ha^{-1}	% Control	Cowpea Grain yield kg ha^{-1}	Striga Count	% Reduction
Sudan and	STR Maize alone	3155a	157	-	150a	36
	STR Maize/Cowpea	2725a	136	650	130a	45
	Cowpea alone	-	-	1625	-	-
Sahelian	Local Maize (CMS 9015)	2010b	100		235b	00
	-	-	-	-	-	-
Savanna	Means	2630	-	-	172	-
	L S D	643	-	-	77	
Northern	STR Maize alone	3650a	145	-	170ab	23
	STR Maize/cowpea	3497a	139	825	141b	36
Guinea	Cowpea alone	-	-	1383	-	-
	Local Maize (CMS 8501)	2520b	100	-	220a	00
Savanna	-	-	-	-	-	-
	Mean	3222	-	1104	177	-
	LSD	530	-	-	51	-

Summary and recommandations

On-farm Striga research indicated that:

The use of tolerant/resistant maize varieties in striga control is promissing.

The use of trap crops wether in rotation or in association with striga tolerant or resistant maize varieties is a plausible alternative for striga management in northern Cameroon.

Burkina Faso: Improvement of the productivity and sustainability of cereal/legume based farming systems through agriculture livestock integration: A strategy for food security in Sahelian and Soudanian zones of Burkina Faso

Poor soil fertility and low rainfall are the major stumbling blocks to the development of agriculture in Burkina Faso. In the north (Sahelian zone) annual rainfall varies from 300 to 600 mm, while in the Soudanian zone it varies from 600 to 1000mm. The main economic activities relate to agriculture and animal production. Livestock rearing is done mostly through free ranging with little grass available to animal during the dry part of the season. Extensive rainfall agriculture is predominant in the region with very little fertilizer input while soils are deficient in phosphorus, nitrogen, potassium, and organic matter.

Through participatory farming system research, INERA has developed technological packages (improved varieties, soil water retention, organic and mineral fertilizer, fodder production and storage, animal feeding).

The objective of this study is to verify on farmer fields, technology packages for cereal/legume production system which integrate livestock rearing for sustainability, improved productivity, and increase in farmer income.

Effects of technology package on cereal production

On-farm verification trials were conducted in three regions: Thiougou and Tiano in the Sudan savanna zone and Pobe in the Sahelian zone.

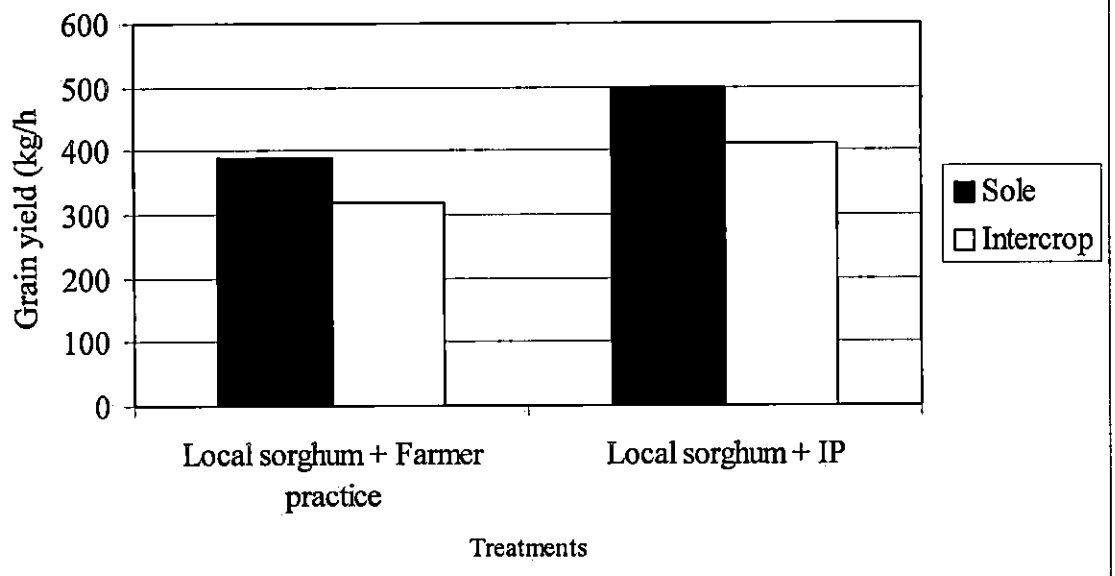
At Pobe Mengao, Tiano, and Thiougou sites, improved varieties of sorghum (Sariasso 14), millet (IKMV 8201), and maize (SR 21), cultural practice (rotation or intercropping) and water retention practices (tied ridges) were compared to farmer practice. Improved cowpea varieties KVX 396-4-5-2D, KVX 414-22-2, and IAR 7/180 were used. Number of farmers per locality was about 10–15. Each plot had a superficie of 168.75 m2. Plant spacing was 0.15 m withing row and 0.75 m between row.

Rainfall in these sites was less than normal and the onset of rainfall was late and very irregular. Furthermore, planting dates varied significantly and adversely affected the crop yield and the performance of the technologies. Farmers who planted before 18 June had on average more than 1400 kg/ha maize grain than those who planted on July 3.

Tied ridging combined with manure increased yield of cereals (sorghum and millet) grown sole or in association with legume **(Fig. 18 & 19).** Grain yield advantage of the technology package was as high as 150 kg/ha for millet and 110 kg/ha for sorghum. Nevertheless, the observed differences were not significant. For maize, highest yields were recorded when grown in association with cowpea **(Fig. 20).**

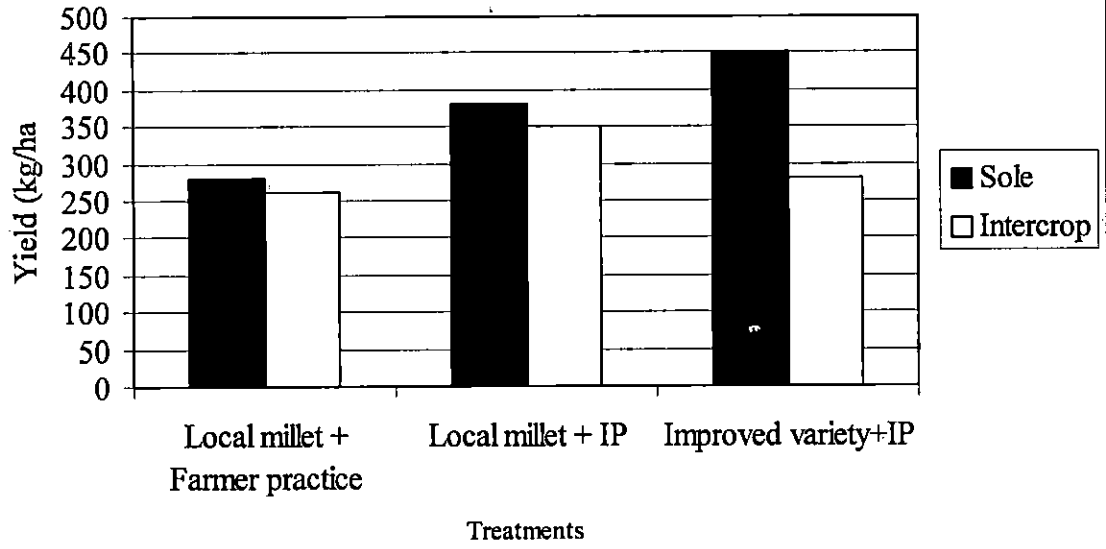
Cowpea yield was positively affected with the use of the technology package. Additional yield of 67 to 103 kg/ha was recorded.

Fig.18. Effect of technology package on sorghum yield at Thiougou, 2000



The economic analysis revealed that: At Pobe, under pure cropping, the improved variety combined with the technological package yielded higher net return per hectare (12754 CFA) compared to the local variety (4720 CFA). This difference is due to both additional grain and stover production, the latter being used for animal feeding. Under intercropping with cowpea, the local variety had a higher net return compared to the improved variety. Since intercropping is usually practiced traditionally, one is tempted to conlcude that the local variety is more adapted to this system of production than the improved variety which was developed for pure cropping. At Tiano, net return was positive only when maize was intercroped with cowpea. When technological package is applied, the improved and local varieties yielded respectively a net return of 116720 and 106900 CFA per ha more than the farmer practice. Under pure cropping, farmer practice was more economically feasible. For sorghum, in Thiougou, the local variety with the technological package had a higher net return compared to the traditional practice wether in pure cropping or in intercroping.

Fig. 19. Effect of technology package on millet grain yield in Pobe, 2000

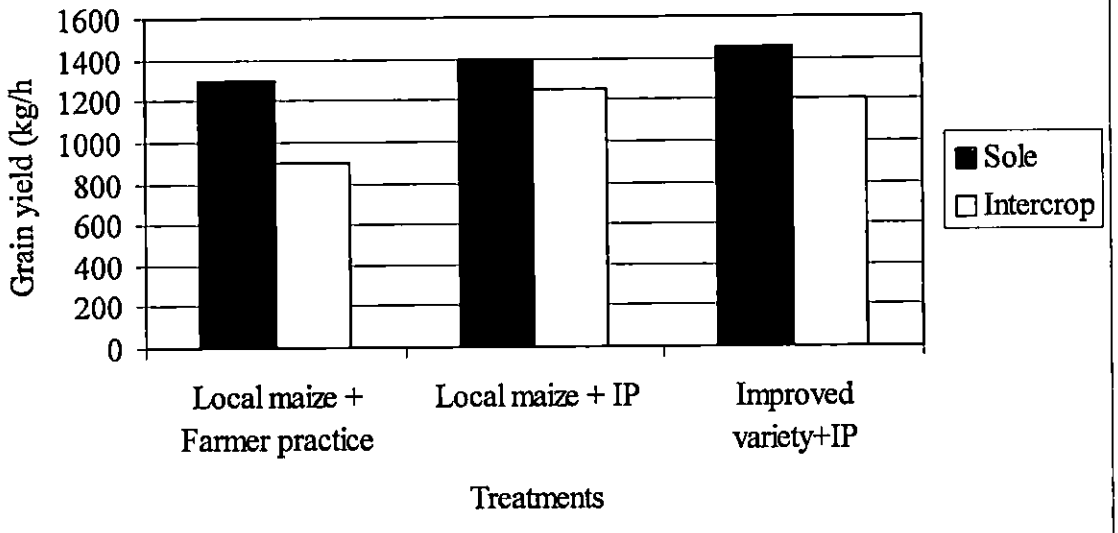


Farmer perception of the technological package

During the field visit, a survey was conducted to determine farmers perception on the technology package. All respondents agreed that tied ridges keep the plots more humid and resist more to drying. On the average, plots with tied ridges can stay moist for 4 days after a good rain compared to two days for the untreated plots. However, farmers noted that this practice is labor intensive. Tied ridging according to them requires the acquisition of animal traction.

A high percentage of farmers appreciated the improved variety of maize SR 21, because of it resistance to lodging compared to the traditional variety. Furthermore, more than 90% of farmers expressed a desire to adopt this variety.

Fig. 20. Effect of technology package on maize grain yield in Tiano, 2000



Integration of small ruminant to agriculture

Livestock component of this activity consisted of small ruminant fattening. Two feed rations were compared. Participating farmers were trained on improved animal fattening techniques in collaboration with the Department of Animal Production of INERA. Themes included fodder harvest and storage, animal selection, animal shed construction, animal health care, etc. Each farmer had 10 sheep in the experimental lot; these animals were dewormed, vaccinated and received one of the feed ration. Their growth performance was monitored.

Average Daily Gain (ADG) of animals were higher in Pobe Mengao (118-153 g) compared to Tiano (47-57 g). This is due to the breed of animals used and also to the experience of producers at Pobe Mengao.

Summary and recommandations

Grain yield advantage of the technology package was as high as 150 kg/ha for millet and 110 kg/ha for sorghum. Nevertheless, the observed differences were not significant. For maize, highest yields were recorded when grown in association with cowpea.

The Socio-economic analysis showed that the technology package when used in sole millet and sorghum production, improve farmer income by 12754 and 13200 FCFA per ha respectively.

SR 21, a streak resistant maize variety was appreciated by more than 90% of the farmers who expressed the desire to adopt it. It has good resistance to lodging compared to the local varieties.

Farmers would like to adopt tied ridging because of its positive effect on soil humidity. However, labor constraint seems to hamper the adoption of this technique.

Average Daily Gain (ADG) of animals were higher in Pobe Mengao (118-153 g) compared to Tiano (47-57 g). This is due to the breed of animals used and also to the experience of producers at Pobe Mengao.

2001-08

Highlights of Agricultural Technology Transfer Activities 1999-2000 - Sustainable Agricultural Program for the Intensification of Food Grain Production in Semi-Arid West and Central Africa

OUA/CSTR-SAFGRAD

OUA/CSTR-SAFGRAD