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West and Central Africa
Research Highlights 2011

1972-2012

40 years of research partnership with
ICRISAT in West and Central Africa

About ICRISAT

The **International Crops Research Institute for the Semi-Arid Tropics** (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners from throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, and 644 million of these are the

poorest of the poor. ICRISAT and its partners help empower these poor people to overcome poverty, hunger, malnutrition and a degraded environment through better and more resilient agriculture. ICRISAT is headquartered near Hyderabad, Andhra Pradesh, India, with two regional hubs and four country offices in sub-Saharan Africa. ICRISAT is a member of the CGIAR Consortium

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Message from the Director General



William Dar | Director General

The programs that ICRISAT is leading on legumes, millet and sorghum are extremely important for global food security. This includes the development of disease-resistant crop varieties and integrated soil fertility and water management towards creating more efficient ways to produce more and better quality food.

The truth of this statement becomes clearly apparent when we flash back on our presence as an agricultural research institute in West and Central Africa during the last four decades.

Going forward, ICRISAT's new strategic plan to 2020 highlights the pursuit of an Inclusive Market-Oriented Development approach for empowering and building the long-term resilience of dryland communities in West and Central Africa.

With this objective, ICRISAT West and Central Africa progressed in 2011 towards achieving the institute goal of improving productivity and increasing the yields of smallholder farmers. As we implement the new strategic plan with its core of inclusive market orientation, ICRISAT shows strong engagement in helping to develop a sustainable farming system that enables resource-poor farmers to reap more benefits from their hard work.

Adaptation to climate change is a major concern for the region's farmers. This report presents some of our major achievements in terms of resilience to climate-related constraints. We also showcase results with regard to crop improvement programs and crop diversification essential to moving from subsistence farming to a paradigm embracing food security and business activity. Studies of our mandate crop adoption show how improved varieties and new technologies have helped to increase farming incomes through boosting productivity and yields.

We also report on our seed projects, which have made significant progress through uptake of improved quality of seed in West Africa, as we continue to work closely with national research institutes on taking the results of findings to their targets. This use of improved seed varieties is seen more than ever in the context of agriculture intensification in West Africa as a necessary measure for increasing production in traditional cereals such as sorghum and pearl millet. It runs hand-in-hand with efforts within the region to improve the business climate for seeds by providing support where required to producers and agro-dealers.



To this end, and together with our partners, we have also developed a distribution strategy that uses small packs of improved variety seed. Uniform packaging, with informative labels in the local language describing the characteristics of the variety, as well as contact information for the seed producers, are important components in the success of this strategy.

In addition, ICRISAT is researching means of improving the nutrition of households. Research was extended to explore how the active involvement of women in farming (on their own account) can increase availability of vital nutrients that will give better child nutrition.

In 2012, as ICRISAT celebrates its ruby anniversary, this report takes you back through a regional journey of four decades and gives voice to some of our pioneers, partners and beneficiaries in looking back at how ICRISAT research has made a difference to the livelihoods of so many smallholder farmers.

We take this opportunity to thank all our partners for their strong support during the passage of the decades. We are also thankful to the national research institutes and the farmers who have been very kind in sharing knowledge that has strengthened our research. We look forward to continuing this partnership to achieve our common goals – a sustainable agricultural sector and eradication of poverty.

William Dar | Director General



ICRISAT at work



Message from

the Director West and Central Africa



Farid Waliyar | Director, ICRISAT West and Central Africa

ICRISAT's strategic plan developed in collaboration with partners gives prominence to small-scale farmers.

The programs developed lay emphasis on their needs and expectations to enable them to obtain better seed of improved varieties, access agricultural credit and markets, and improve their resilience to environmental adversity, in particular the effects of climate change. The region's economy remains fragile and it is mainly affected by food insecurity. Year 2011 again resulted in very low rainfall and the entire Sahelian zone is facing severe food shortages. Our programs are geared towards producing a long-term solution to this challenge.

As we celebrate the ICRISAT 40th anniversary in 2012, let me briefly highlight achievements from our crop improvement, soil and water management programs, and our seed systems. ICRISAT's Drylands Cereals program and partners have released about 32 varieties of pearl millet and 55 varieties of sorghum and six hybrids. Most of the sorghum varieties combine early maturity and tolerance to drought and Striga. The improved pearl millet variety, Super SOSAT-C88, is an example of the highly successful breeding work carried out over recent decades in collaboration with national programs in the region. This variety, originally developed in Mali in collaboration with IER and Niger in collaboration with INRAN, was released in other countries, including Mauritania, Burkina Faso, Nigeria and Cameroon. The variety combines high yield, early maturity and very good grain quality.

The legumes program, which focuses on groundnut improvement, has developed and disseminated a wide range of varieties having farmer- and market-preferred traits. These include short to medium maturity, resistance to foliar diseases or to groundnut rosette, tolerance to drought and aflatoxin contamination.

In addition to varieties, integrated crop management technologies to increase yield by reducing crop loss due to diseases have been developed. A simple and cost effective, rapid test kit developed by ICRISAT for the detection of aflatoxin contamination in groundnut is helping farming communities to reduce aflatoxin contamination and thus enhancing quality.

The crop improvement programs are supported by a repository of more than 40,000 germplasm accessions conserved to international standards in a gene bank at ICRISAT-Niamey, Niger. Of these, 6,000 are from national programs to secure these unique national genetic resources. The genetic resources are available to all those who request, especially plant breeders.

Integrated management of Striga and soil fertility in sorghum and pearl millet has shown agronomic and economic benefits in farmers' fields in Mali and Niger. To ensure large-scale and good quality transfer of information to farmers, we facilitate information exchange between research, extension and farmers through innovative pathways including, radio, video and user-friendly printed messages translated into local languages.

I wish to thank all our partners who have been and continue to be very supportive of our journey to better the livelihoods of poor farmers in the dryland tropics of West and Central Africa. Happy anniversary to ICRISAT and join us as we pursue the implementation of our strategic plan to 2020. Together we can build new levels of prosperity in the agricultural and food sectors in West and Central Africa.

Farid Waliyar | Director, ICRISAT West and Central Africa

Biofortified crops and optimal management systems elevate crop nutritional quality

Life-giving nutrients under scrutiny

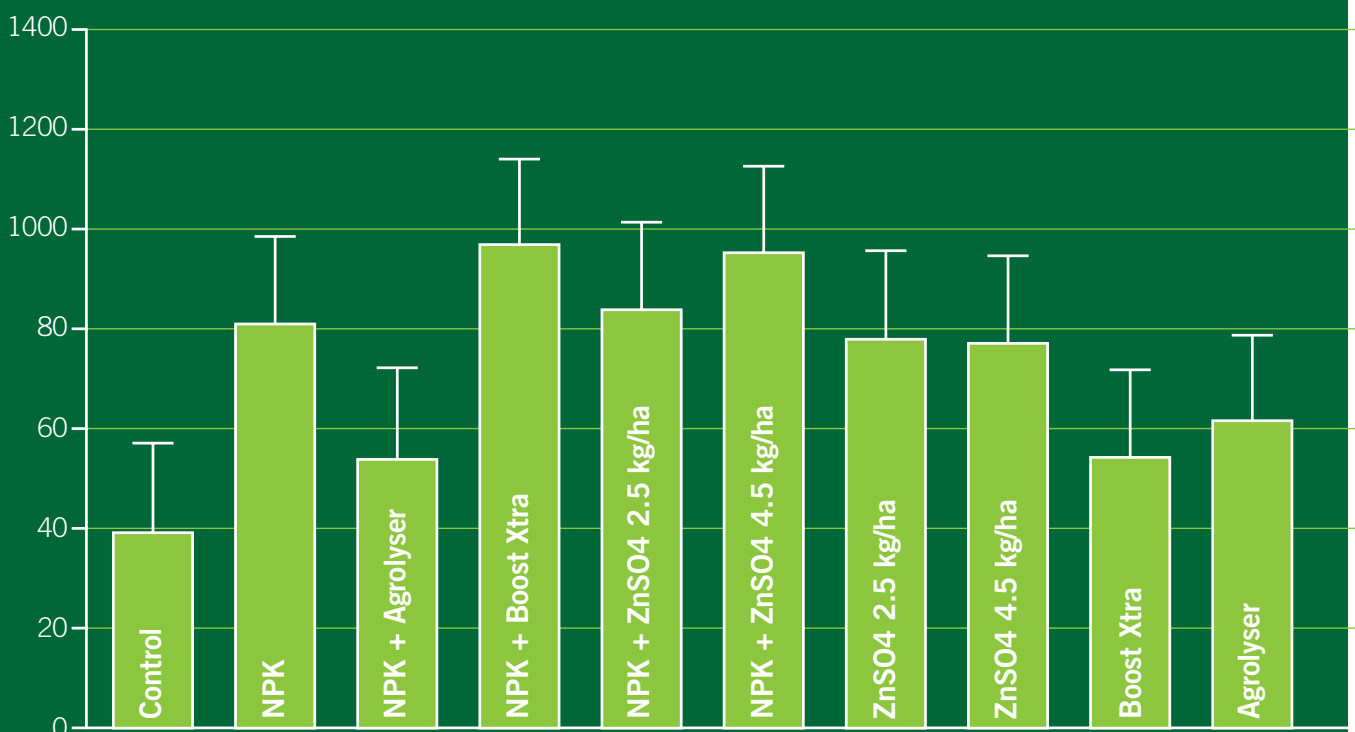
Nearly 500,000 children under five years of age die annually because of zinc (Zn) and iron (Fe) deficiencies in their mainly cereal-based diets.

In countries with high incidence of micronutrient deficiencies, certain cereal crops that are inherently very low in grain Zn concentrations are grown on potentially Zn-deficient soils further reducing Zn concentration in grain. Bio-fortification of cereal crops with Zn has unsurprisingly become a high-priority global issue, and action is being taken in West Africa.

One local landrace and one ICRISAT improved millet variety were grown at two sites in Niger using 10 options for nutrient management, while two sorghum varieties were similarly grown in Mali and Nigeria. A split-plot design was used in four replications. The main plots contained the nutrient management options. Leaf application was the method used for Sulfate Zn, Agrolyser (20% NPK, 0.15% Fe and 0.075% Zn) and Boost Xtra (20.14% Ca and 0.11% Zn). Crop production was evaluated in addition to grain and stover nutrient content.

Grain yield varied with the different nutrient management options. However, the greatest effects were obtained from NPK alone or combined with Sulfate Zn or Boost Xtra (Figure 1). The application of 2.5 kg.ha⁻¹ of sulfate zinc has similar effect to 5 kg.ha⁻¹ dosing. The combination of NPK and Agrolyser resulted in a lower yield, as did Agrolyser and Boost Xtra applied alone. This is an indication that those fertilizers influence grain quality improvement but not necessarily yield increase. NPK (15 15 15) combined with Sulfate Zn increased ICMV IS 89305 Fe content compared to initial status by 175% and Zn content by 50%. This positive change is 200% and 12% respectively for Sadoré local. Boost Xtra alone increased Fe content of the improved variety by 130% and the local variety by 118% whereas Zn content increase was 2% and 40% for the same varieties respectively. Considering yield performance and nutrient content the best combination so far is NPK (15 15 15) with Sulfate Zn planted with millet variety ICMV IS 89305

Figure 1: Effect of nutrient management on millet grain yield. Sadoré 2011



Biofortification of staple food crops

Increased nutrients from women's farms for improved child nutrition

As much as 69% and 75% of the total energy intake of children and mothers, respectively, comes from cereals, according to a food consumption survey conducted by ICRISAT and partners in several farming communities in Southern Mali. In addition, 48% and 69% of the dietary zinc intake of children come from cereals¹.

Sorghum – the principal cereal consumed in these farming communities – is generally considered a “men’s crop”, with men traditionally being responsible for the production and supply of grains in the family. Women, on the other hand, grow ‘sauce crops’ such as groundnuts and vegetables in their generally lower-fertility fields, although they increasingly grow sorghum and contribute to family grain stocks when harvests are low. Since this grain from women farmers’ fields is primarily used to prepare an additional meal for children, it presents an opportunity to contribute to children’s food and nutrient intakes by improving productivity and nutrient (i.e. zinc) content of grains.

An ICRISAT study looked at the effect of zinc fertilization on iron (Fe), zinc (Zn) and phytate contents of sorghum varieties tested on women’s farms. In addition, the effect of zinc fertilization on the iron and zinc bioavailability – estimated with phytate:iron and phytate:zinc molar ratios – and the relationship between soil parameters and grain iron and zinc contents were studied.

Different test varieties for each zone were tested by 31 women farmers in the Mande and Dioila zones of Southern Mali. Each farmer tested two improved varieties and a farmer-selected local check. One part of each plot was fertilized with zinc sulphate (1 g/m²) and the other left as a control. Fertilization was done 1 to 7 weeks after sowing. Grain samples from nine farmers were mechanically decorticated for two and a half minutes and analyzed for their Fe, Zn and phytate contents. Soil samples were also taken and analyzed for soil phosphorus available to the plants (using Bray P1), organic carbon and pH.

Soil zinc fertilization had no effect on grain iron and zinc contents and bioavailability. This could have been due to the small sample size of the study, the timing



Woman farmer harvesting sorghum from her farm in Mande Zone, Mali

of fertilization or, possibly, low soil fertility and possibly because zinc is not limiting in the soil. However, soil P, pH, organic carbon and Bray P1 appeared to be important soil parameters for grain zinc content and could completely explain farmer differences in grain zinc.

On the other hand, organic carbon and pH appeared to be important parameters for grain iron, although they could not completely explain the differences observed between farmers. Grain iron was positively related to organic carbon and pH while grain zinc was positively related to soil P availability, soil P and organic carbon, but negatively to pH. It is recommended that this experiment be repeated with a larger sample size and accurate timing of fertilization taken into account.

¹ Smit MA, Nyirandutiye D, Weltzien E. Food consumption study in farming communities in Mali. Unpublished data Wooten S. (2003).

Table 1: **Soil fertility parameters of women's farms in the Dioila (n=4) and Mande (n=5) zones**

Zone	Dioila	Mande
Soil P (ppm)	117.7 ± 17.8	103.2 ± 4.7
Bray P1 (ppm)	4.8 ± 1.8	5.1 ± 2.7
Organic carbon (%)	0.4 ± 0.1	0.4 ± 0.1
pH	6.1 ± 0.1	5.8 ± 0.1

Table 2: **Relationship between soil parameters and the iron and zinc contents of decorticated grain of 10 sorghum varieties**

Soil parameters	P-value* of grain iron	P-value* of grain zinc
Soil phosphorus availability (Bray P1)	0.30	0.04
Soil phosphorus	0.25	<0.001
pH	0.03	0.003
Soil organic carbon	<0.001	0.03
Farmer	0.04	0.14

*: P-value or F-probability of regression analysis

Table 3: **Means of iron, zinc and phytate-P concentrations in decorticated grain of 10 sorghum varieties tested by nine women farmers in the Dioila and Mande zones in 2009 and their iron and zinc molar ratios**

Variety	Iron (ppm)	Zinc (ppm)	Phytate-P (ppm)	Molar Ratio [phytate:iron]	Molar Ratio [phytate:zinc]
Aligeri	17.7	17.1	1457	25	30
Baki-Baki	26.9	25.8	2423	27	33
Kitaka	24.7	22.7	2325	28	36
Local Nionifing	24.1	17.1	2174	28	45
Niogome	29.0	23.4	1804	19	27
Nionifing*	18.8	16.7	1346	22	29
Seguetana*	20.6	15.6	1837	29	45
Tieble*	25.3	18.0	2144	28	44
Trukani	19.2	14.9	1429	25	35
Yalama*	20.4	19.0	1733	25	32
s.e. ¹ of difference	1.7	1.1	297	3	4

*: Test varieties. The rest are local/check varieties. ¹ s.e.: standard error



Crop diversification: Fruit and vegetables to boost to incomes and diet

To diversify agriculture from cereal monoculture and to fight against poverty, the crop diversification team at ICRISAT-Niamey has developed the African Market Garden (AMG), which promotes the production of highly nutritional vegetables and fruits through drip irrigation.

Two AMG projects at Tanka and Yelou communities in Niger were completed during 2008–2010 and further supervised during 2011–12 to allow farmers to manage the new irrigation infrastructure and technologies successfully and to develop highly productive systems of vegetable production.

With a total investment of 35,000 US dollars in 2011, farmers were trained in the optimum use of drip irrigation, accurate dosing of organic and inorganic fertilizers, improved vegetable seed and varieties, and production marketing.

A nursery and tree propagation infrastructure within Sadoré Experimental Station was improved during 2011 to ensure production of high quality seedlings of fruit tree varieties to be planted at AMGs. These plants are also sold to the general public.

Table 4: Trees sold from ICRISAT nursery in 2011; earnings used for nursery improvements

Tree species	Quantity sold	Area (Ha)	Place
Date Palm	1,375	13.75	Mali, Burkina Faso
Mango	5,537	35	Niger
Citrus Pomelo	9,224	33	Niger
Pomme du Sahel	11,596	29	Niger
Moringa	9,582	4	Niger
Papaya	931	1.5	Niger
Figs	200	0.3	Niger
Sweet Tamarind	337	4.8	Niger
Henna	4,790	-	Around fences
Acacia senegal	647	1.6	Niger
Acacia tumida	700	-	Wind break
Saba senegalensis	277	-	Ornamental
Vetiver	7,680	-	Erosion control



Nursery made using local materials for Ziziphus (pomme du sahel) propagation



Improved nursery for mango propagation



Date palm tissue culture hardening tunnel

To promote ecological and landscape restoration, the crop diversification team has also developed the project 'Bioremediation of Degraded Lands' (BDL), which recovers highly degraded lateritic lands while enhancing production of rainfed vegetable and fruit with high nutritional values. Forty BDL sites were developed during 2011 with funding from the USAID-Arziki (Niger food security) project to a total investment of 120,000 dollars.

For the long-term sustainability of the AMG and BDL technologies, the crop diversification team developed the "Farmers of the Future" (FoF) program focused on training primary school teachers and students to build and manage AMGs, tree nurseries and BDLs for high quality vegetable and fruit tree production while recovering and conserving the land. Three FoF projects were developed during 2011 within the bounds of three primary schools in the district of Libore, Niger, with a total investment of 13,000 US dollars for ICRISAT technical support.



Primary school teachers and students training. Hands-on development and management of AMGs and BDLs at three schools within the district of Libore, Niger

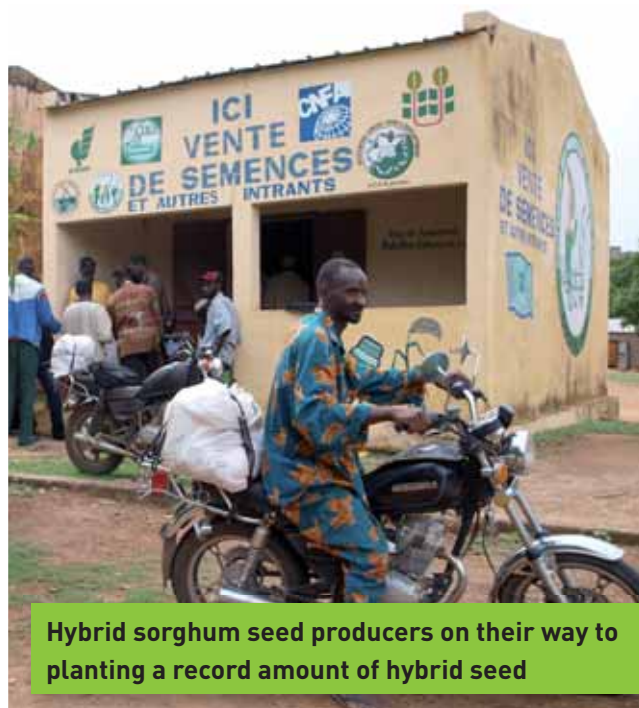
Increasing productivity of dryland cereals to help end hunger

New sorghum hybrids offer yield advantages

Hybrid varieties of sorghum are not new but attempts to introduce them into West Africa floundered until local germplasm was incorporated for stable mold and insect resistance. Now, even farmers with poorly performing soils can gain half a ton in extra yield per hectare with the right hybrid.

Although sorghum hybrids have been commercialized for several decades in many parts of the world, the lack of hybrids with the required adaptation prevented their success in West Africa. The first hybrids produced in the region were based on introduced parents and were not commercially viable owing to their susceptibility to grain mold and insect attack, and to the poor quality grain that resulted.

However, ICRISAT and the Institut d'Economie Rurale (IER) have jointly developed new hybrid parents with grain quality and adaptive traits contributed by local germplasm. These new parents, developed over the past decade with support from the Rockefeller Foundation, were used to produce the first series of sorghum hybrids with Guinea-race grains. These hybrids were extensively tested in on-farm trials to assess their productivity under farmer-managed conditions across a broad diverse range of growing conditions.



Hybrid sorghum seed producers on their way to planting a record amount of hybrid seed



Hybrid sorghum variety "Fadda" (foreground) and landrace variety "Tieble" (background) with part of the ICRISAT-IER team of sorghum researchers

The set of eight shorter height hybrids produced 40% more yield than the very well adapted landrace variety "Tieble", averaged over 34 on-farm trials in Mali between 2009 and 2011. And the check variety, Tieble, is actually one of the best available local varieties and production and sale of its seed is important in this zone. Thus the 40% average yield superiority of all hybrids, and the even higher 51% superiority of the two best hybrids "Fadda" and "Sewa", means that farmers have a truly major opportunity for increasing sorghum productivity under their growing conditions through use of hybrids. Furthermore,

the hybrid yield advantages were large under low- as well as high-productivity conditions. In fact, Fadda and Sewa had 60% yield superiorities over Tieble across the nine lowest productivity conditions; increasing grain yields by an average of 420 kg/ha in environments with average yields of just 1.0 to 1.5 t/ha (Fig. 2 and 3). Furthermore, there was not a single case of Fadda or Sewa yielding significantly less than the check variety over all of the on-farm trials. Thus these hybrids do not represent any risk for farmers but rather an opportunity for increasing yields across the entire range of productivity conditions.

Table 5: Mean yields (t/ha) of eight hybrids and two check varieties across trials of low-, intermediate- and high-productivity, and the superiority of yield relative to the local variety Tieble over 34 trials in Mali between 2009 and 2011

Name	Type	Mean Yield g m ⁻²				% of Check Variety averaged over individual trials		
		Low-Yld Trials (n=13)	Int.-Yld Trials (n=10)	High-Yld. Trials (n=11)	all trials	Low-Yld Trials (n=13)	Int.-Yld Trials (n=10)	High-Yld. Trials (n=11)
Fadda	Hybrid	1.6	2.1	2.8	2.1	60	50	40
Sewa	Hybrid	1.6	2.1	2.8	2.0	63	49	40
Massa	Hybrid	1.5	2.1	2.8	2.0	52	51	43
Yougo	Hybrid	1.5	2.0	2.7	2.0	51	51	33
Mona	Hybrid	1.4	2.0	2.9	2.0	47	19	42
Mara	Hybrid	1.4	1.7	2.7	1.9	44	20	33
Sigui kumbe	Hybrid	1.2	1.8	2.6	1.8	24	40	26
Gamo	Hybrid	1.3	1.8	2.5	1.7	27	31	22
Lata	Improved Variety	1.2	1.5	2.2	1.6	-	-	-
Tieble	Local Variety	1.1	1.5	2.1	1.5	-	-	-

Figure 2: Hybrid Fadda yield superiority

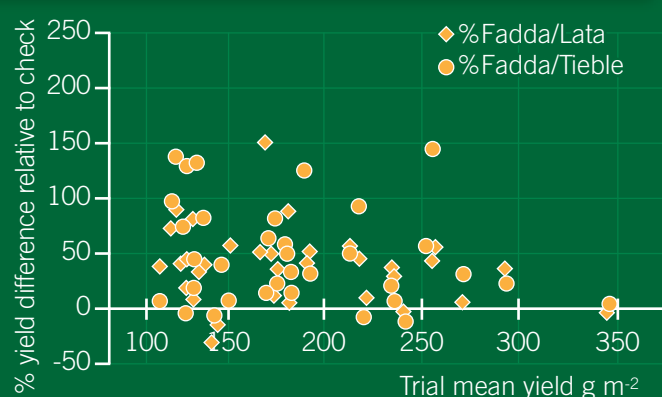
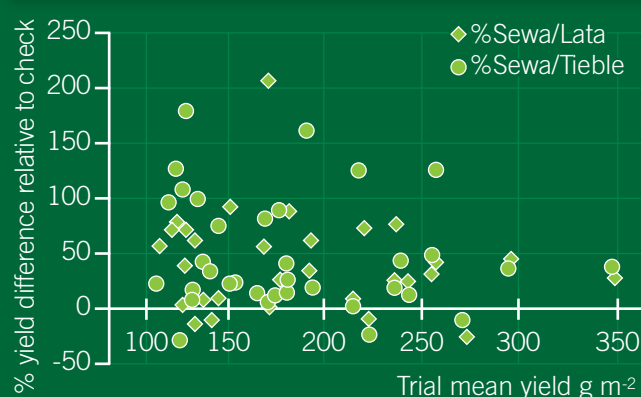


Figure 3: Hybrid Sewa yield superiority



Reducing vulnerability

Integrated management options for insect pests in pearl millet

Damage caused by insect pests can sharply reduce the yield and marketability of pearl millet crops so non-chemical approaches to reducing yield losses are being investigated in Niger.

Focus switched in 2011 to the effects of millet intercropping and rotation with cowpea on incidence of Millet Stem Borer (MSB) and Millet Head Miner (MHM). An experiment conducted at ICRISAT-Sadoré using a RCBD (randomized complete block design) with five replications and four treatments: 1) solo pearl millet (inter-row and intra-row spacings of 0.80 m); 2) solo cowpea (inter-row and intra-row spacings of 0.80 m and 0.40 m, respectively); 3) pearl millet-cowpea intercrop (2 rows of pearl millet - 1 row of cowpea with densities of 0.80 m x 0.80 m - 0.80 m x 0.40 m); and 4) pearl millet-cowpea intercrop (2 rows of pearl millet - 2 rows of cowpea with densities of 0.80 m x 0.80 m - 0.80 m x 0.20 m). Plot dimensions were 12.8 m x 12.8 m. Pearl millet and cowpea cultivars were, respectively, ICMV IS 99001 and TN 5-78.

Results showed that millet grain yield was significantly higher in the solo crop treatment (1,338 kg/ha) compared with the other two intercropped treatments (average 879 kg/ha) containing pearl millet, but there was no significant difference in terms of cowpea seed yield between treatments 2, 3 and 4 (average 217 kg/ha). Nor was there significant difference between treatments in terms of the percentage of stems and spikes damaged by MSB and MHM (respective averages of 53% and 99%). Since cowpea seed value is on average two-fold that of millet grain, the three treatments 1, 3 and 4 were economically equivalent. However, positive residual effects from cowpea intercropping are likely to appear in the second year, as compared with millet alone.

The severity of damage by MHM on pearl millet spikes and by MSB on pearl millet stalks in an INRAN (Niger National Agricultural Research Institute) trial was also measured in 2011. This study of long term effect of pearl millet-cowpea rotation (cv resp. HKP and KVx 30 306-6G) and microdose fertilization on production has been conducted at Konni for the last six years and consists of four blocks: treatment 1 (no fertilizer and with rotation); treatment 2 (with fertilizer, with rotation); treatment 3 (no fertilizer, no rotation); and treatment 4 (with fertilizer,





Sampling soil macrofauna in a cowpea sub-plot, Sadoré, Niger

no rotation). Each block comprised 5 sub-plots of five 32 m pearl millet rows (inter-row and intra-row spacings of 1 m), alternating with 5 sub-plots of five 32 m cowpea rows (inter-row and intra-row spacings of, respectively, 0.80 m and 0.40 m). No significant differences were found between treatments in terms of percentage of MSB and MSM-damaged pearl millet stems and spikes, or mean numbers of holes per stem or of mines per spikes. On the other hand, mineral fertilizer application had a detrimental effect on ground predators (mainly spiders, centipedes and antlions).

Earlier results obtained in the same trial at Konni in 2009, had shown that while there was no difference for MHM incidence, there was a tendency ($P < 0.10$) for MSB (1.5 ± 0.4 holes per stem in the millet-millet rotation compared with 0.6 ± 0.7 in the millet-cowpea rotation). In a similar trial conducted the same year at Kollo INRAN station near Niamey, there was a tendency ($P < 0.10$) for MHM incidence (1.9 ± 1.1 mines per head in the millet-cowpea rotation, compared with 0.7 ± 0.4 in the millet-millet rotation). These earlier results suggested that stems of millet rotated with cowpea were less infested by MSB (probably due to the absence of in-field pest carry-over population), while they were more attractive to MHM (probably due to better N-nutrition). This is an additional instance of needed trade-offs between short term vs long term benefits vs drawbacks of new cropping systems.



Sampling soil microfauna in pearl millet sub-plot, Konni, Niger



Pearl millet spike with Millet Head Miner damage, Konni, Niger

Pinpointing drought responses using lysimeters

Pinning down the reasons why some crop varieties outperform others under the same amount of drought stress demands very special testing for which ICRISAT-WCA is now well equipped.

Past investigation of groundnut and cowpea for response to drought stress has often been done separately, resulting in the identification of traits conferring drought stress tolerance, certain of which contribute to better drought adaptation in either crop.

Therefore, it was felt that testing contrasting genotypes of groundnut and cowpea simultaneously could contribute to comparison of the responses to drought and identify any common related traits.



Transpiration measurement with lysimeter tubes

New lysimeter system

A lysimeter phenotyping facility established in 2011 at ICRISAT-Sadoré in Niger was used to assess 20 contrasting genotypes of groundnut and 20 genotypes of cowpea during rainy season 2011. Water stress was imposed at flowering stage. Plants were covered with a rainout shelter to prevent rainfall effects during water stress imposition. A lysimeter crane balance was loaded with the tubes (cylinders) for initial weighing and later determining the water lost by transpiration. Control plants were compensated for transpired water, and traits were measured on control and stressed plants from one day after emergence through to harvest. Genotypes with high yield under water-stress conditions were identified for both groundnut and cowpea. SPAD chlorophyll meter readings (SCMR) and leaf area revealed traits conferring drought tolerance in groundnut while transpiration and harvest index were found to be drought-related traits in cowpea. The results showed that water use-efficiency could be a common trait for drought tolerance in groundnut and cowpea. Groundnut may control its water use by adjusting the leaf area whereas cowpea adjusts stomata for conserving water during drought stress.

Pearl millet

Pearl millet is widely grown in the Sahel where water deficit and phosphorus deficiency (low P) in the soil are known to be the main limiting factors of productivity. The new lysimeter system was also invaluable in assessing 18 contrasting West African pearl millet varieties under water deficit and low soil phosphorus conditions.

Eighteen varieties of pearl millet were planted in 360 cylinders (1 m x 35 cm) filled with low phosphorus soil from Sadoré farm; half (180) of the cylinders undergoing



low phosphorus (LP) treatment while the remainder received 6 g of DAP to represent a high phosphorus treatment (HP). For both treatments, half of the cylinders were water-stressed. Water lost by transpiration was compensated for well-watered (control) plants while water stress was imposed to stress plants from heading time to harvest and traits were measured on both control and stressed plants.

The results indicated that the varieties responded differently under the two water regimes and between the two phosphorus treatments. Water stress significantly decreased most of traits measured during water-deficit periods. Seed weight, shoot weight and transpiration decreased under LP conditions for most varieties (Figure 4). Significant interaction between genotype, phosphorus treatment and water regime was observed for the time taken to maturity (Figure 4).

LP and water stress delayed the maturity of all varieties except ICRI_Tabi and PE05572. Doga_C2_Pf_comb, Serkin_C2_Kandela_SMS, GBx99001_YLD_2009 and PE08039 varieties were tolerant for seeds and ear weight under low P conditions while Ankoutess and Strigares_expvar_ep_long_noir were shown to be sensitive to the conditions.

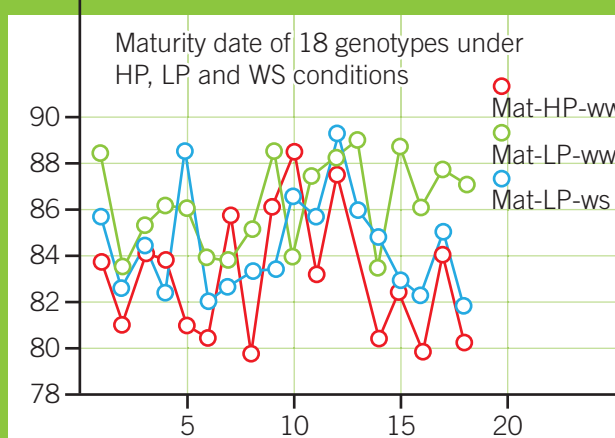
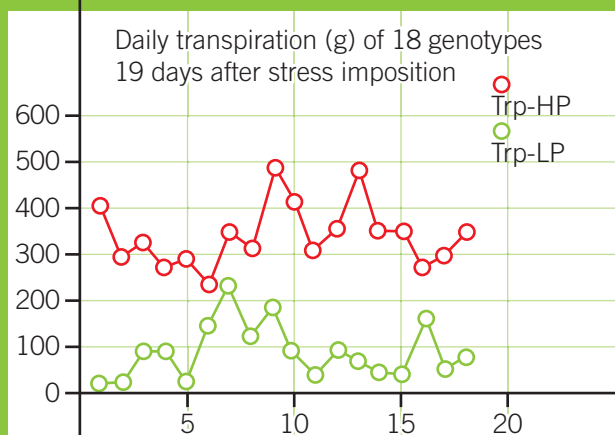
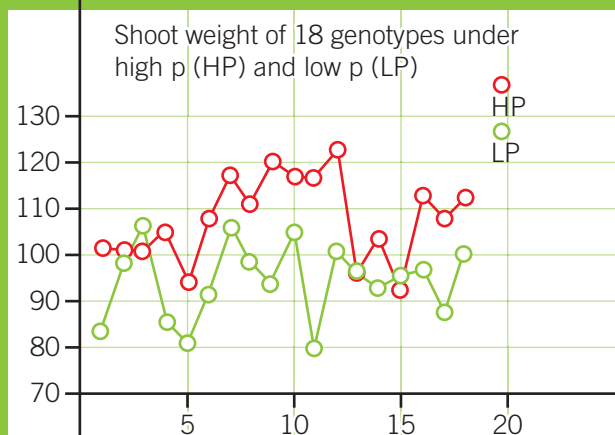
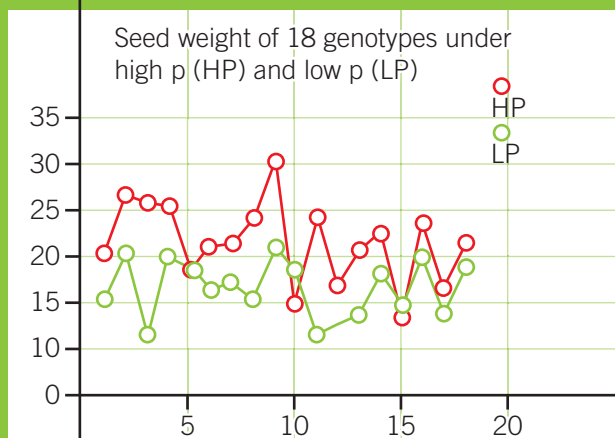


Figure 4: Seed weight, harvest index, transpiration and maturity of 18 pearl millet varieties under high phosphorus (HP), low phosphorus (LP) and/or well water (ww) and water stress (ws) conditions

Markets

Capacity building for a sustainable commercial seed industry

Quality sells! Increased sales and incomes for seed growers and traders provide confirmation in several countries where the West Africa Seed Alliance Seed Project (WASA-SP) is active.



A field day on hybrid sorghum in Northern Nigeria

In 2009, the United States Agency for International Development (USAID) along with the Alliance for a Green Revolution in Africa (AGRA), the Economic Community of West African States (ECOWAS), the African Seed Trade Associations (AFSTA) and several multinational seed companies initiated the public-private partnership known as the West Africa Seed Alliance (WASA) to establish a sustainable commercial seed industry in West Africa. The Seeds Project,

being the major mechanism through which USAID channels its support to WASA, is implemented by ICRISAT in partnership with the Seed Science Center of Iowa State University (SSC/ISU) and the CNFA (Citizens' Network for Foreign Affairs). The Seeds Project's main objective is to strengthen the seed system in West Africa through the harmonization of seed policies, the strengthening of the seed value chain and the development of seed business.

In focusing on capacity building of the key stakeholders in seed policy, seed value chain and seed business areas, the project has conducted two types of training: classroom-based training and on-the-job capacity building around demonstration plots.

Testimonials assembled during a recent assessment of project performance revealed an increasing demand for quality seeds, better management of the enterprises by the agro-dealers trained, the development of new marketing strategies, and an increase in revenues drawn from the seed business.

NAFASO – more than a seed company

“I don’t just feel like an agro-dealer pursuing purely economic interests. Farmers can also count on my support to provide them with seeds in times of crisis,” says Abdoulaye Sawadogo, head of the NAFASO Seed Company, Burkina Faso.

Fifty agro-dealers and six members of the farmers’ union in Burkina Faso received training through WASA-SP in 2010. A poor crop season followed in 2011, with 143 communes declared food-insecure, and the Burkinabe government initiated dry season production of maize. NAFASO, fresh from the WASA-SP training, was able to play a major role in preventing food crisis by supplying 17 tons of maize seed for redistribution by the State to regional seed producers.

The adoption of improved varieties has contributed to increased production as WASA-SP training has made NAFASO’s extension agents more efficient in running their demonstration plots and farmer field schools, now standing at 140 demonstration plots and 36 tours, while more than 4000 data sheets and brochures have been made available for extension of improved production techniques.

NAFASO is a good example of what can be achieved with training support in a country – or even a sub-region – where development of the seed sector is lagging behind. In 2010/2011, NAFASO earned revenue of about 200 million FCFA, and the company expects to reach 1,300,000,000 CFA by 2015 through continuing development and consolidation of the seeds network and seeds distribution in Burkina Faso.

“Our goal is to cover the maximum number of localities and ensure that farmers and producers have access to better quality seeds and appropriate technical support to underpin agriculture and lead to food self-sufficiency,” adds Abdoulaye Sawadogo.

“With technical support from WASA we have delivered the 17 tons of hybrid seeds that were needed by the government to prevent food crisis. We are not just a business company pursuing its own interests. WASA-SP has enabled us to capacity build and take care of farmers in hard times as well.”

WASA-SP capacity building activities will be continued with the aim of developing a market-oriented seed system in West Africa.



Sawadogo Abdoulaye (left), Head of the Nafaso seed company with Sawadogo Idrissa, NAFASO seed company production manager

Adoption studies

Less means more as Sahel farmers make the most of the microdose experience

By reinforcing the availability of improved seed and microdose fertilizer management through low interest loans, many thousands of small farmers in three West African countries were able to increase their crop yields and their household incomes. In all, nearly half-a-million households are thought to have been touched over two years.

In 2009, the Alliance for a Green Revolution in Africa (AGRA) asked ICRISAT to backstop three national project teams working in Burkina Faso, Mali and Niger on the wide-scale dissemination and adoption of the Fertilizer Microdosing and Warrantage System. Identical objectives were set by AGRA for all countries with the aim of increasing major crop yields by at least 50% and increasing the revenues of 360 000 households in the project sites by 30%.

ICRISAT's backstopping role for each country's implementation activities was fulfilled by:

- Putting in place project management structures in each country (coordination staff, steering committees, soil health consortiums)
- Holding regular project meetings (launching, mid-term and end-of-project workshops)
- Capacity building and scientific support to country teams
- Reports evaluation and transmission to AGRA
- Synthesis and dissemination of project achievements to stakeholders

This resulted in dissemination of microdosing technology through demonstrations on 28,039 plots and through 438 farmer field schools (FFS) in the target countries. Local personnel were trained by ICRISAT in managing the infrastructure to service the dissemination; 161 input stores were built or rehabilitated to sell inputs such as fertilizer, improved seed, pesticides and services, while a further 151 warrantage stores were established to store and sell grain, and provide credit to farmers and farmer associations. Warrantage (inventory credit based on using farmers' produce as collateral) management teams were trained: 95 teams in all, each composed of three managers, including at least one woman in each team.

Major banks and finance institutions were linked with farmer organizations for preferential low interest credit arrangements. Between 300 million and 500 million CFA were made available in each country based on deposited guarantee funds from the project.



These credit arrangements helped the project achieve some remarkable results:

- More than 4,000 tons of fertilizer sold in input stores and for the FFS and Demo plots were acquired directly through project funds; additional quantities were purchased from other sources under evaluation;
- More than 66.5 tons of improved seed of millet, sorghum, cowpea, groundnut, vegetables and sesame were sold through the input stores;
- An estimated 30,000 ha of land was brought under microdosing fertility management across the three countries;
- About 472 600 households were estimated to have been reached by the microdosing technology;
- Income-generating activities through warrantage provided additional returns of more than 30% (ex. of Mali);

The project results show that microdosing of fertilizer application as a method of intensifying crop production in the semi-arid region of West Africa has good potential. Millet grain yields increased from 300–500 kg/ha to 1,000–1,200 kg/ha thanks to the use of 30 kg/ha of compound fertilizer together with improved seed. This strong potential has been demonstrated both for increasing income through additional yields, but also through inventory credit schemes (warrantage) providing direct benefits to farmers.



A training session in a farmer's field on Integrated Genetic and Natural Resources Management (IGNRM)

Adopting modern groundnut varieties in Nigeria

Nigeria is one of the world's largest groundnut producers, accounting for 10% of world production, 39% of Africa's groundnut production, and 51% of the total production in West Africa.

Prior to 1980, groundnut production decreased significantly due to groundnut rosette virus incidence and drought, coupled with stringent export restrictions due to aflatoxin contamination. However, since 1984 the decline in production has been halted and now reversed with annual growth from 1984-2008 estimated at 8%, resulting both from area expansion (6%) and increased productivity of 2%. Groundnut is both a major cash and food crop for many households in Northern Nigeria where it accounts for 21% of rural cash earnings and is a major source of employment.

Since 1990, ICRISAT and the Institute for Agricultural Research (IAR) in Nigeria have developed and tested or adapted 44 groundnut varieties in partnership with the State Agricultural and Rural Development Authorities (ADRAs) of Kaduna, Kano, Katsina and Jigawa states. As a result, three varieties (UGA 2 (SAMNUT 21), M 572.80I (SAMNUT 22) and ICGV-IS 96894 (SAMNUT 23) were formally released from this program in 2001. Further research in the same states found that farmers preferred three other varieties (ICIAR 19BT, ICIAR 6AT and ICIAR 7B), which were not formally released, but are currently being planted by farmers. The adoption of these varieties will make a significant contribution to increased food security, improved health, enhanced sustainability of the natural resource base of adopters of these varieties, and bring about a subsequent reduction in rural poverty.

Following the release of these varieties, efforts were initiated to promote and increase access to and availability of seed of the preferred varieties for end-users through the groundnut seed project funded by the Common Fund for Commodities (CFC) from 2003-2007 and the Tropical Legumes II program in other villages in the same states from 2007 to 2010. The major objectives of these projects were to promote varieties and empower communities and seed companies in seed production and delivery of preferred varieties. As a result of these project interventions, more than nine varieties are available, 4 tons of breeder seed; 25

tons of foundation and 400 tons of certified seed have been produced and sold to end-users. More than 500 farmers have been trained in groundnut seed production technologies and more than 75 farmers have been trained in small-scale business skills and marketing.

After two decades of intervention, it is likely that the efforts of ICRISAT and its partners have had a significant impact on the livelihoods of rural households. A survey was carried out in December 2011 and January 2012 among major groundnut producers in 10 states, namely Bauchi, Borno, Gombe, Jigawa, Kaduna, Kano, Katsina, Niger, Yobe and Zamfara. A nationally representative sampling framework was used to estimate the number of villages to be surveyed per state based on prior knowledge of probability of adoption by the state²; a confidence level of 5% and adjustment ratio of 10%



Freedom from rosette disease boosts yields

² The probabilistic adoption per state was estimated to 30% in Kano, 15% in Jigawa, 15% in Katsina, with the remaining 40% equally distributed between the states Bauchi, Borno, Gombe, Kaduna, Niger, Yobe and Zamfara.

in case of missing household heads and other reasons. A total of 270 villages were selected randomly in each of 10 states, and 10 households were randomly selected per village. The survey was implemented using two types of questionnaires: village and household questionnaires. The modern varieties under investigation include SAMNUT 21, SAMNUT22, SAMNUT23, ICIAR 19BT, ICIAR 6AT and ICIAR 7B. These varieties are tolerant/resistant to the rosette virus and are early maturing.

Preliminary results show that about 25% of households were exposed to modern varieties released since 2001. SAMNUT21, SAMNUT22 and SAMNUT 23 account for 80% of the modern varieties known to the farmers surveyed. The majority (41%) of information on modern varieties is obtained through farmer-to-farmer exchange, on-farm trials (25%) and ADPs (18%). In terms of area planted, modern varieties account for 13% of the groundnut planted area or about 287,000 ha of groundnut area. The major reasons for non-adoption of modern

varieties are the non-availability of seed (39%), non-timely availability of seed for 8%, low yielding varieties (10%), low market value (8%), not good in intercropping (12.5%), and other reasons including high seed cost, disease problems and high fertilizer requirement.

Poor access to and availability of seed of modern varieties remains the major constraint to adoption of modern groundnut varieties, followed by lack of access to and affordability of other essential inputs such as fertilizers and pesticides. Efforts by the Nigerian government to facilitate access by poor farmers to essential production inputs such as seed, fertilizers and credit are highly desirable. This will require a public-private partnership in which the private sector will play a major role in the provision of essential business services. Scaling-up seed production and delivery options such as community-based seed systems and tasking communities with the production of certified seed, but especially foundation seed, is essential.

Extra early-maturing, rosette- virus- resistant groundnut variety released in Nigeria

Partnership between international and national researchers has produced a high performance, disease-resistant groundnut variety that can safeguard growers' returns from losses due to rosette virus in Sahel regions.

Groundnut rosette is the most destructive disease of groundnut (*Arachis hypogaea* L) in sub-Saharan Africa. It causes annual losses ranging from 10-30% in Nigeria, rising to 100% in an epidemic. Both predominant early-maturing varieties – 55-437 (or EX- Dakar) and RRB – grown in Nigeria are highly susceptible to the disease. Rosette-resistant varieties such as RMP 12 and RMP 91, SAMNUT 21 and SAMNUT 22 are late maturing (> 120 days to maturity) and can be grown successfully only in the northern Guinea zones of Nigeria. More than 50% of Nigerian groundnuts are produced in the Sahel savanna agroecological zone where the growing season is short (90–100 days).

ICIAR 19BT was jointly developed by ICRISAT and the Institute for Agricultural Research (IAR) at Samaru, Nigeria. The initial cross between an early maturing genotype and a late maturing rosette resistant line (ICGM 751/754 x ICGV 87922) was made by ICRISAT.

ICIAR 19BT remained on the shelf from 2002 until 2007 when it was included in the participatory variety trials (PVS) staged during 2008–2010 in three Nigerian states (Kano, Jigawa and Kastina), and subsequently approved for release for the Sahel savanna zones as SAMNUT 24 in December 2011. The major characteristics of this variety, which is a Spanish botanic type with high (54%) oil content, are that it matures in less than 90 days from sowing to maturity, is resistant to rosette and has yield potential of 2000-2500 kg/ha. ICIAR 19BT represents the culmination of nearly 20 years of breeding and line selection for agronomic fitness and resistance to rosette. It also shows how collaborative research between a CGIAR center and a national program can combine efforts to solve a production constraint.

Technology dissemination

Seed mini-packs break down the barriers to successful diffusion

Cheap and affordable seed mini-packs are transforming the way in which smallholder farmers can access the seed of improved varieties of sorghum and millet.

Areas cultivated with improved seed of traditional cereals such as sorghum and pearl millet are very limited in West Africa. In Mali, for instance, less than 20% of sorghum area is planted with improved seed. The traditional seed system, in which buying and selling seed is an unfamiliar concept, is one reason for this situation. Another cause is the limited access by smallholder farmers to the seed of improved/preferred varieties. Sorghum and pearl millet seed has conventionally been commercialized directly by seed cooperatives or government agencies, which offer only limited points of sale. Dissemination of new varieties thus tends to be slow and does not reach large numbers of farmers.

In Mali, Burkina Faso, Niger and Nigeria, around 27 improved varieties and hybrids of sorghum and more than 15 improved varieties of pearl millet were produced in 2010/2011. With the aim of increasing diffusion of modern varieties and thereby the impact of seed on farmers' production systems, these improved varieties were chosen for formal release based on farmer preferences and superior agronomic performance.

Low cost

Seed mini-packs were introduced to enable farmers to test out a new variety under their own conditions over a minimum area of 100 m² and thus be able to compare its performance with their own (local) varieties. The seed mini-packs contain between 100 g and 500 g per pack, are uniformly packaged and are labeled in the local language, with information on each variety's characteristics as well as providing contact information for the seed producers. These components have proved crucial in the success of this strategy. The price (between 50 and 100 FCFA) for one pack of 100 g is affordable for smallholder farmers.

Over the past two years, eight farmer seed cooperatives in Mali, Burkina Faso and Niger have produced certified seed of varieties and hybrids and then employed the mini-pack strategy for the diffusion of this seed. They also collaborated with agro-dealers, NGOs and private seed enterprises in Mali. In Nigeria, various projects were responsible for the mini-pack distribution. The principal points of sale were cooperative seed stores, local markets, village meetings, agricultural input shops, and seed fairs.



Employees of the COPROSEM producers' cooperative in Mali manufacture mini seed packs



Selling point for ICRISAT mini-packs of improved varieties in Mali

The diversification of information sources (radio, markets, meetings, fairs, television) further helped with this diffusion. To facilitate monitoring and evaluation, vendors were asked to document the number of mini-packs sold and to maintain lists of buyers as well as the names and villages of these buyers.

Awareness

In all, about 9,403 pearl millet and 10,476 sorghum mini-packs (OPV and hybrids) were sold in 2010 in Mali, Niger, Nigeria and Burkina Faso. In 2011, more than 9,000 sales were recorded for sorghum and more than 3,000 for pearl millet in Burkina Faso and Mali alone. Most farmer organizations increased mini-pack production in 2011, and some sold over 2,000 packs extra. Three farmer seed cooperatives reported stopping mini-pack production because farmers increasingly asked for larger quantities of the available seed (1 kg or more). For example, the UACT in Mali increased its sales of bulk seed (400 kg certified) in 2011 thanks to increased awareness among farmers of the availability of improved/preferred variety seed.

Effective distribution

The diversity of points of sale for mini-packs is shown in Figure 5. In particular, the collaboration with agro-

dealers and their distribution networks allowed the farmer seed cooperatives to expand points of sale outside of their normal zones of intervention and create links with agricultural input shops. To increase awareness of mini-pack availability, local radio stations were approached by seed cooperatives and agro-dealer networks to inform about the mini-pack sales. In 2011, more than 2,000 seed packs were sold in Mali alone through agro-dealer networks and private seed enterprises. Farmer feedback from the 2010 sales indicated that about 68% of mini-pack buyers in southern Mali planned to increase their test area for the new varieties in 2011. In this part of Mali, the mini-pack strategy reached farmers from all five different socioeconomic farming categories present.

The continuing and increased interest in buying seed mini-packs, as well as increased sales of bulk seed noted by the seed cooperatives, confirms that the mini-pack approach is an effective method for raising awareness of modern varieties and thus aiding their diffusion. The approach not only highlights the success of breeding programs that aim to offer farmers a wide diversity of adapted and preferred varieties, but also shows that traditional smallholder farmers in West Africa are becoming more receptive to the idea of buying and selling seed.

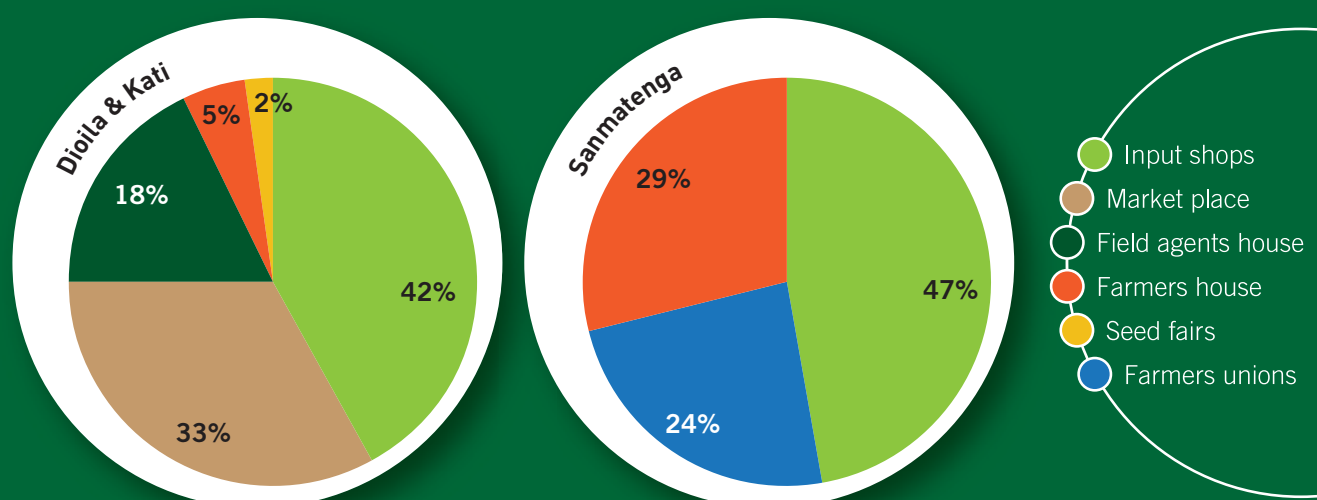


Figure 5: **Selling points: mini-pack purchases by 56 farmers in Mali (Kati and Dioila), and 517 farmers in Burkina (Sanmatenga)**

Zooming in and out on Striga: bringing science to life with farmer-to-farmer videos

“Fighting Striga” may not be a Hollywood – let alone Nollywood – blockbuster but it is set to grab the attention of farmers throughout Africa.

Scientists from ICRISAT and fellow international research organizations have invested heavily over the past 40 years in finding solutions to one of the world’s most troublesome weeds—witch weed or Striga. This parasitic weed seriously damages maize, sorghum, millet, rice and fonio. While developing Striga-resistant varieties is a key area of research, scientists also developed insights into how soil fertility management and other options can help to reduce Striga infestation. However, scientific knowledge in itself has proved insufficient to make an impact, as researchers and extension agents struggled to communicate effectively with farmers on such a complex matter.

Since 2006, ICRISAT and partners have embarked on farmer field schools to help farmers experiment with a wide range of ideas and options for Striga control. As a result, practical and profitable integrated Striga and soil fertility management (ISSFM) practices have been developed for pearl millet and sorghum. However, the scarcity of skilled trainers and the requirement to maintain quality training while scaling up are bottlenecks.

Inspired by the Africa Rice experience farmer-to-farmer videos, ICRISAT decided its experience with farmer field schools provided the key building blocks for a number of videos related to Integrated Soil Fertility Management.



Participants in a workshop in Ghana produce their first high quality farmer-to-farmer training video



A farmer demonstrates how to check airtightness of storage bags for cowpea seed



Farmers attend video projection during a farmer exchange visit in Soufroulaye, Mali

ICRISAT staff and the staff of partners in Niger, Nigeria, Ghana and Mali were trained by a specialist agency in farmer-to-farmer video conception and production. One year later, a comprehensive series of 10 farmer-to-farmer videos was ready for wide-scale dissemination under the name "Fighting Striga", and being used by ICRISAT and partners in farmer exchange visits. Based around evening screenings, several videos, such as those on composting, crop-livestock interaction, intercropping cereals with legume crops, and cowpea seed storage have been shown and discussed at community open-air shows.

Christine Keita, one of the farmers from Souara village in Mali featuring in the compost video, recalls her experience of a farmer exchange visit organized by ICRISAT: "Farmers from different regions in Mali and

Burkina Faso came together in Koutiala to learn how we controlled Striga. Although our crops were close to harvest we could show them on the video all the different steps needed to make good compost and how to apply it to the crop. They were all very excited to see me in the video, so afterwards they asked me lots of questions. As I had learnt so many things at the farmer field school, I felt really proud and confident to answer their questions."

The "Fighting Striga" videos developed by ICRISAT are effective because they are made according to the zooming-in, zooming-out (ZIZO) method. This method relies on strong interactions with farmers who have been involved in participatory approaches, such as farmer field schools. The ZIZO method results in regionally relevant and locally appropriate farmer-to-farmer training videos and can be applied to many topics to bring a bit of life to science.



Farmers are filmed while observing the effects of Striga control techniques on pearl millet in Madiama, Mali

Who we are

Scientific staff list

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Director, West and Central Africa



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Assistant regional director/ Principal scientist (breeding) – grain legumes



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Pierre CS Traoré *France*

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Chief of party, WASA – markets, institutions and policies



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Kano, Nigeria



Hakeem Ajinde Ajeigbe *Nigeria*

Principal scientist/country representative – resilient systems

1972-2012



The International Crops Research Institute for the Semi-Arid Tropics was created in 1972 and has a long-term commitment to the Sahel. In this report, we want to celebrate some major achievements through the voices

of our partners in West and Central Africa. We also want to honor those farmers who were involved in the research process at various levels via a participatory approach. With all, we want to celebrate our ruby anniversary.

Mali

In Mali, ICRISAT's cooperation began with a joint research program with the Institut d'Economie Rurale (IER) aimed at establishing a strong national infrastructure for long-term research on sorghum and pearl millet cropping systems. Evaluation of sorghum and pearl millet varieties and other exotic material was begun by a breeder/agronomist Dr SVR Shetty, who was joined a year later by a second agronomist Dr Noel Benninati, with project funding being assumed by USAID/Mali. More than three decades later, we went back to Dr Shetty, who laid the foundations of ICRISAT in Mali as the first Country Representative.

Raghuram (SVR) Shetty:

first Country Representative in Mali



"At the very beginning, we were based at the Sotuba research station with the IER national program and working on a small program in which ICRISAT was invited to collaborate with research on sorghum and millet. In collaboration with the partners in place, we also contributed to building the infrastructure that established the IER Research station in Cinzana (Segou region). Our help extended to capacity building of scientific staff (some were sent for in-house training in India at ICRISAT headquarters and others to undertake PhD degrees in the USA). The Malian government accepted early ICRISAT as part of their national research institute and this partnership has led to many scientific innovations and adoptions.

Now, the main challenge is how to transfer these new technologies to farmers' fields. When I visit farmers' fields, I can see the gap between the developed technologies and those technologies transferred. There's a lot to be improved; we need to identify the main hindrances to technology adoption. We need to create a market for commodities via strengthened partnerships. Now, the private sector

in India is leading the seeds business. For the same to happen in Africa, we need to create an enabling environment for the expansion of ICRISAT market commodities so that seeds can move easily within ECOWAS. I also think that farmers are willing to produce and market a diversity of crops. **ICRISAT is doing well!"**

When ICRISAT started its activities in Mali, Dr Bino Teme was a scientist at the beginning of his career in the Institut d'Economie Rurale. Now, Dr Teme is IER Director General and retains good memories of the past years of collaboration with ICRISAT.

Bino Teme:

Director General of the Institut d'Economie Rurale (IER)



"ICRISAT has trained for Mali about 50 technicians and scientists in Hyderabad (India) on research methods since its installation in Mali. Secondly, I would cite the establishment of a powerful Geographic Information System (GIS) Laboratory at the Sotuba center. In terms of research, scientific collaboration has led to the adaptation and selection of several varieties of groundnut, sorghum and millet, including the pearl millet variety SOSAT widely adopted by producers throughout the Sahel region. The development of the hybrid sorghum race Guinea is a further highlight of this cooperation. I should also mention the development of a screening method using molecular markers for resistance to Striga in sorghum (a major problem facing farmers within the region). Finally, I will mention the adaptation of cultivars of *Zizyphus mauritiana*, the implementation of the Desert Margins Program and the development of methods of fighting against pests (diseases, insects, weeds)."

1972-2012 40 Years of Research Partnerships with ICRISAT in West and Central Africa

Niger: diversified partnerships

Collaboration between ICRISAT and Niger dates back more than 30 years. ICRISAT helped define the strategic plan for agricultural research in Niger. The country research program (INRAN) was also associated with almost all ICRISAT research projects in West Africa by making available some of its stations, including those at Gaya, Maradi and Konni, for partnership trials. Genetic work on millet, sorghum and groundnut for varieties adapted to the Niger climate and tolerant to certain constraints such as Striga on millet and other diseases of sorghum and groundnut were developed. In Dosso region groundnut varieties that contribute to improving the processing of this production were adopted.

Gouro Abdoulaye:

Director of the Niger Agronomic Research Council (CNRA)



"Certainly the contribution to human capacity building is the most significant, with lasting impact. The institute has improved and, especially, diversified partnerships to spread its impact to producer organizations, rather than remain confined to research facilities. Its areas of intervention have gradually expanded to take in other forms of production. This is very important for Niger and the entire region.

Happy birthday to ICRISAT! I wish this anniversary initiates a new era in which ICRISAT and national structures demonstrate that our semi-arid ecosystem is in no way synonymous with non-productivity, and that research is the vanguard of agricultural development. LONG LIFE TO ICRISAT!"

Boukari Wassalké:

Minister of Agriculture of Niger (2000-2003)



"ICRISAT has played an irreplaceable role in research and training. Looking to the future: technology transfer to farmers' organizations and development projects deserve to be supported with increased funding. On the occasion of its 40th birthday, I wish to congratulate the entire staff of ICRISAT for its skill and dedication.

I express my best wishes to this wonderful organization that works tirelessly to help ensure greater food security in the world."

Burkina Faso: significant and lasting impact

Collaboration between ICRISAT and the Institut de l'Environnement et de Recherches Agricoles (INERA) of Burkina Faso, dates back to 1974 when ICRISAT initiated its activities in the Sahel. ICRISAT was located at Kamboinsé, about 15 kilometers from the capital Ouagadougou. Research activities related to breeding, crop protection, training, and production systems were conducted at different sites/study villages. In the 1990s, collaboration between ICRISAT and INERA moved towards implementing ecoregional initiatives and research networks. As we celebrate ICRISAT's fortieth anniversary, Dr François Lompo, Director General of INERA, our main partner in Burkina Faso has more to say.

Dr François LOMPO:

Director of Institut de l'Environnement et de Recherches Agricoles (INERA)



"Training of researchers and technicians has had significant and lasting impact on the generation and implementation of research programs, particularly those on millet, sorghum and groundnuts. Varietal collaboration between INERA and ICRISAT led to the generation and dissemination of varieties such as ICSV1049, Framida, E35-1 and the IKMP series, which are

always disseminated in Burkina Faso and have helped improve agricultural production.

The use of modern biotechnology for sustainable management of natural resources in contexts of climate change and land degradation, and the socioeconomic impact assessments of technologies generated are potential areas of collaboration from which we expect a rise in regional collaborative programs."

Macoumba Diouf:

Director of the Senegalese Institute of Agricultural Research (ISRA)



"From 1980 to 1995, ICRISAT had a number of researchers working in Senegal in the Bambey and Kaolack localities. In particular, the initial collaboration on millet produced several varieties (IBV 8004, IBV 8001 and IBMV 8402) for release in Senegal. From this collaboration, ISRA inherited more than 500 lines ranging from F1 to F7.

At the sub- regional level, ICRISAT has established strong relationships with the National Agricultural Research Systems (NARS), and created several networks that receive funding to conduct research and permit ISRA to work synergistically.

Over recent decades, ICRISAT has provided more than 10 varieties of millet for cultivation and popularization throughout West Africa, and contributed to sub-regional projects.

However, in my opinion, the achievements of ICRISAT in West and Central Africa, which will have greater long-term impact are those linked to capacity building. Senior scientists from ICRISAT have helped considerably with their experience, their intellectual and material support. ICRISAT was able to position itself as a leading agronomic research institute in West Africa".

Professor Balarabe Tanimu:

Director, Institute for Agricultural Research (IAR) ,Ahmadu Bello University, Zaria



"The most significant achievements of ICRISAT in Nigeria remain the development and release of a number of sorghum, millet and groundnut improved varieties, as well as the training of young Nigerian scientists in crop breeding. I would say that ICRISAT has achieved most of the objectives for which it was set up. The only areas in which it should do more are in the areas of drudgery reduction, socioeconomic and marketing. Nigerian farmers will benefit more from technologies developed through this collaboration.

The Institute for Agricultural Research, Samaru, has more collaborative projects with ICRISAT than any other member of the CGIAR and I pray that the almighty will lead ICRISAT into conducting more reaches with a human face".

FARA-ICRISAT:

Ramadjita Tabo worked for ICRISAT for 23 years (1986 to 2009) and had the privilege of working in many of its stations including Patancheru/ Hyderabad, India; Kano/Bagauda, Nigeria; Bamako/ Samanko, Mali; and Niamey/Sadoré, Niger. He witnessed all the challenges and also all the achievements and impacts that ICRISAT had on the livelihoods of the smallholder farmers of Africa and Asia. While a member of ICRISAT staff in 2007, he was a joint recipient of the Nobel Peace Prize as a member of the Intergovernmental Panel on Climate Change (IPCC). He is now Deputy Executive Director of the Forum for Agricultural Research in Africa (FARA), an Apex organization bringing together and forming coalitions of major stakeholders in agricultural research and development in Africa.

1972-2012 40 Years of Research Partnerships with ICRISAT in West and Central Africa

Dr Paco Sereme:

Executive Director of the West and Central African Council for Agricultural Research and Development (CORAF/WECARD)



“When we developed the CORAF/WECARD Strategic Plan, it became very clear that there had to be a focus on drylands cereals (millet and sorghum) – also among ICRISAT mandate crops – and on other commodities such as rice, maize, roots and tubers, and livestock if we want to increase productivity and agricultural growth to 6% as recommended by the NEPAD in West and Central Africa. That is shown in the study ‘Regional Strategic Alternatives for Agriculture-led Growth and Poverty Reduction in West Africa’ carried out in 2006 by IFPRI and sponsored by CORAF/WECARD. ICRISAT participation in the CORAF scientific committee is therefore very beneficial with regards to strengthening partnerships with stakeholders dedicated to these two drylands cereals. ICRISAT has also a proven track record in the field of innovation

platforms and agribusiness incubators and has inspired us to create similar platforms and incubators for the region under the coordination of FARA, which is our Apex body.

Nowadays, it is not enough to produce, we must also combine processing and access to markets in order to diversify and increase farmers’ income. These are areas in which ICRISAT has considerable experience on which CORAF/WECARD will count during the coming decades.

Today, the entire world is exercised by the issues of climate change, yet these are major issues on which ICRISAT has worked and gained a proven experience via its Sahelian centers”.

a participatory approach brought success

Dr Ramadjita Tabo: Deputy Executive Director, FARA

“I believe that ICRISAT has provided an excellent forum and platform for researchers and other key stakeholders in the region to undertake sound research for development work that addresses the key constraints to production. ICRISAT has developed, in partnership with the NARI partners: i) improved varieties and hybrids of sorghum, millet and groundnut that are high yielding, tolerant and or resistant to drought, major pests and diseases and are of good nutritional quality; ii) improved management practices that increase the efficiency of use of natural resources namely water and nutrients; iii) integrated pest management

options. I see great opportunities to use FARA’s mandate to develop and strengthen the collaboration between FARA and ICRISAT in alignment with the CAADP framework and through the strategic platform that links up various stakeholders. FARA and ICRISAT could share experiences and knowledge on innovation systems along the value chains, appropriate policy options, capacity strengthening and advocacy for increased and harmonized investment in agricultural research for development in Africa”.



IFAD-ICRISAT: vibrant rural areas and profitable agriculture

Dr **Kanayo Nwanze:**

IFAD President, formerly ICRISAT West and Central Africa Director, 1982 to 1985



"In my view, ICRISAT did outstanding work in West and Central Africa. The participatory on-farm breeding and selection of sorghum, which was implemented in conjunction with national research institutions, brought significant results for many small farmers who obtained seeds for new pest-resistant varieties that produce higher yields of grain. I encourage ICRISAT to continue its investment in pro-poor research that will contribute to lifting millions of people out of poverty and hunger. The new CGIAR Research Programs that are currently being developed and approved are a good example of this commitment to partner with regional and national research centers as well as universities. This new approach will engage available expertise to carry out research as well as develop a pool of new scientists.

Preventing famine in West and Central Africa

There is no magic bullet, no secret formula that will eliminate poverty and hunger overnight. There are many solutions, but each must be targeted to the conditions of a specific region, or even a specific village.

I believe that Africa can feed itself. Sub-Saharan Africa has around 60 per cent of the world's uncultivated land, and uses only one-tenth of the average amount of fertilizer. If the African continent increased use of fertilizer, improved seeds and irrigation, there could be significant improvement in crop yields without causing environmental damage.

In my view, ICRISAT should continue to focus on the major food crops of the semi-arid areas of the region – namely sorghum, millet and associated legumes. The availability of improved seeds is critical so that farmers do not need to consume their seeds during famines. ICRISAT could assist in establishing strategic seed banks for the region that stock seeds in case of famine.

The institute should also further pursue its work on micro-irrigation technologies in West Africa with other research centers. This field will continue to be important for the region, and its work on mini-dosing of fertilizer should be up-scaled to boost cereal productivity to increase food security for rural women, men and children.

ICRISAT is an important institution. Not only to me as the President of IFAD, but also for me as a scientist and researcher. ICRISAT is where I developed my scientific ability; it is where I nurtured my management skills and where I started developing an important insight into today's agricultural development issues and their historical origins. I wish ICRISAT continued success in its priority research programs, and stamina advocating for agricultural research around the world with the innovative power to adjust to a changing environment and reality. I look forward to the day, when our joint efforts have made rural areas vibrant places and agriculture a profitable business".

1972-2012

CNRA (Mali)–ICRISAT: building hope in the agribusiness sector

Prior to occupying his position at CNRA and on the ICRISAT Governing Board, Adama Traoré was seconded to the Food & Agriculture Organization of the United Nations as Chief Technical Adviser in charge of Research and Development of small-scale livestock production in Togo. Adama has served on the boards of many international organizations, including FARA, the sub-regional organization,

CORAF/WECARD, where he served as Chair and the International Institute of Tropical Agriculture (IITA), where he served as a board member. He is also a board member of AfricaRice.

A veterinarian by profession, with a PhD in Veterinary Medicine gained at Karl Marx University, Leipzig, Germany, he is a specialist in livestock reproduction.

Adama Traoré:

Research Director and Executive Secretary of the National Committee on Agricultural Research (CNRA) in Mali; member of ICRISAT Governing Board



“Having worked closely with ICRISAT, I recognize the importance and relevance of its intervention areas, which cover three-quarters of African countries, including most of the poorest in the world. These fields have expanded in response to climate change in recent decades.

In Mali, there has been much collaborative research on varietal aspects (including sorghum, millet and groundnut) and other joint work that focused on the fight against Striga and aflatoxin, both of which are areas that are highly relevant to all countries in the African dryland tropics sharing the aim of achieving food security and reducing both poverty and land degradation.

I particularly appreciated the great effort made by ICRISAT in the seed sector through its participatory breeding approach. When this first targeted the rural poor areas, it was gradually extended to promoting a public-private partnership for the emergence of a professional seed sector. ICRISAT’s work on fertilization through the use of microdosing has also elevated the interest of many small farmers in this technology.

As head of Mali’s National Committee on Agricultural Research (CNRA), I welcome the institutional innovations stemming from ICRISAT’s research in agricultural development through a participatory approach with researchers, farmers and development

agents. Thanks to this policy, many research activities were carried out jointly with national agricultural research systems within the framework of special projects.

Institutions are often criticized for implementing unsuitable technologies. But, as part of its innovations, ICRISAT has created a platform of research incubators that provide advisory support and training from which countries are nowadays more willing to benefit.

Support to the agribusiness sector will remain a strong element of the interventions by ICRISAT, and as a member of its governing board I encourage the institute to continue within this framework. With its ‘inclusive market-oriented development strategic plan (IMOD) towards 2020’, ICRISAT will strengthen the links between the poorest countries and agricultural markets. This is an opportunity for these countries to raise themselves above the vicious circle of pessimism. I enjoyed working with officials from ICRISAT (including Dr. Farid Waliyar (ICRISAT Director West and Central Africa, who is well acquainted with the French agricultural and research system, and also worked for 10 years as a scientific advisor of the CNRA). The good collaboration with ICRISAT Director General, Dr. William Dar must also be mentioned here. While institutions are important, it is men that ensure their good management. Good luck and success to ICRISAT for the next forty years.”

Farmers have their say

Balla Berthe and Namakan Keita from Kénério—sorghum producers

As we celebrate our ruby anniversary we also want to celebrate real people who really matter to us—the farmers who have constituted our main target within the region during the past decades. From development of varieties, to their adoption, ICRISAT worked intensively with smallholder farmers trying to overcome adverse climatic and agricultural conditions over the past decades. We are thankful to them.

In Mali (Keniero), two farmers Balla Berthe and Namakan Keita, who have worked with the ICRISAT-IER sorghum improvement teams/activities over the past decade, were interviewed by Fred Rattunde, an ICRISAT principal scientist, who works with farmers daily.

Balla Berthe's first response when quizzed on changes due to a decade of collaboration with the ICRISAT-IER Sorghum Improvement team was to highlight the knowledge gained: knowledge of, and attention to knowing the origin and purity of seed, and thus being able to avoid "semences fatiguées" (tired seed). He says collaboration has brought greater diversity of varieties. "For the family, they no longer "know" (experience) the hunger period, with the possibility now of producing larger quantities and selling

some. Previously, I produced much cotton, but it is decreasing in favor of sorghum; I am also earning money from seed production, which I am increasing year by year. If all goes well I will continue to produce seed," says Balla Berthe.

Namakan Keita, another farmer from Keniero, agrees that he has learned many things about crop management options. "Before collaboration, self-sufficiency was a problem. Since I adopted improved varieties (Soumalemba, Grinkan, Soumba) developed by ICRISAT and IER it contributes to self-sufficiency. I can even sell some my production. In 2011, the local variety Seguetana gave only three sacks off 0.5 ha whereas I harvested 30 sacks from my field (1.5 ha) of the improved variety Lata."



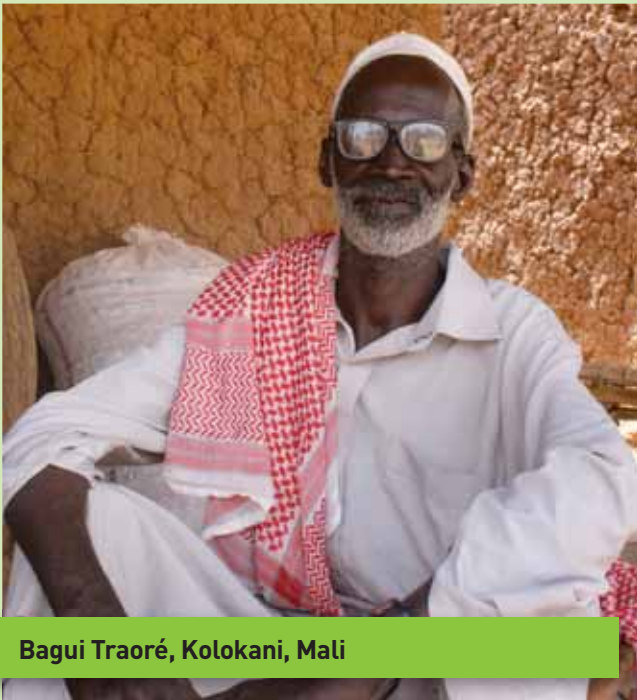
Balla Berthe from Kénério, Mali, shows us an improved variety developed with ICRISAT and carrying his name

1972-2012

Passion for peanuts

A story of friendship transcending generations

For farmer Bagui Traoré (Kolokani, Mali), meeting with ICRISAT was the beginning of several decades of collaboration and friendship fostered by a common interest in peanut cultivation and study.



Bagui Traoré, Kolokani, Mali

He particularly welcomed the addition of Waliyar Tiga ICG 7878 to the list of groundnut varieties proposed by ICRISAT during the Institute's journey in West and Central Africa. 'I think it's a variety of very good quality because it is resistant to foliar diseases, its seeds are large and weigh heavier, and this variety has good haulm yield usually used as animal feed,' says Mr Traoré. 'The seeds are sold at 750 FCFA/kg while local varieties are sold at 500 FCFA. Thanks to their sale I was able to reinvest income into the purchase of materials for farming. In particular, I was able to purchase some oxen.'

Building and strengthening capacities

Increased productivity and performance cannot be attributed solely to the dissemination of varieties. Prior to their adoption, ICRISAT and partners developed techniques, including integrated management of aflatoxins, that improve the way in which sowing, weeding, harvesting, conservation and selling of peanuts are carried out. 'I've learned to use products

such as lime, fertilizer and crop residues to increase productivity and yields,' Mr Traoré points out. 'This had the effect of reducing the aflatoxin content of peanuts that I produced. Now I know better how to meet the national and international standards when working in the field, harvesting my peanuts and conditioning them properly until the sale and consumption'.

Bagui is not the only farmer in Kolokani to receive assistance and to experience ICRISAT improved varieties and techniques for integrated management of aflatoxins. Other farmers were trained on how to create seed companies and commercialize seeds. After these training sessions, the Kolokani farmers took the initiative to organize themselves in a cooperative of producers called Yeleton. This cooperative became stronger and credible to banking institutions such as the Banque Nationale de Developpement Agricole du Mali (BNDA). The association was able to obtain credit finance from the Bank to expand its activities to vegetable crops. The Government has also supported the farmers by providing the cooperative with a fully equipped tractor to cultivate their collective farm and the individual farms belonging to members. The tractor also earns money for the cooperative, which hires it out to non-members.

So successful has the federation been that news of its success spread beyond the borders of Mali, resulting in fact-finding visits by farmers from Guinea, Mauritania and Senegal.

Improved household health

According to Bagui Traoré, before the intervention of ICRISAT many people were constantly complaining of stomach bloating and constipation after eating peanuts. 'Since using simple and practical methods to reduce aflatoxins learned from ICRISAT



A group of women working for the seed cleaning and packaging assembly line

researchers, people nowadays complain less of these ailments since we applied the techniques of integrated management of aflatoxins," he said.

Better groundnut resistance to drought and aflatoxin

In a continuing effort to meet the needs of the region's farmers, ICRISAT and partners regularly renew the stock of varieties. The last renewal was two years ago when new varieties more resistant to drought and aflatoxin were introduced and tested by farmers who have guarded seed carefully for future seasons.

Mr Traoré prefers a variety resistant on station to aflatoxin ICGV 91317 because of its attributes such as early maturity, drought resistance, excellent pod filling and yield, plant vigor and reduced gleanings after harvest. In addition this variety has good yield of haulm usually used as animal feed.

Bagui Traoré can be considered an exceptional witness to ICRISAT's presence in Mali over the recent decades and he believes that the development of human resources remains the most significant contribution that ICRISAT has provided to improve smallholders' livelihoods. "Farmers were able to organize themselves into associations and then federations. We have learned to produce seeds of quality and we also know how to market our production and get more income. Banks and financial institutes trust us. We can produce quality peanuts for our own consumption and our people are much healthier. What more could we expect?"

All that Bagui Traoré asks is that ICRISAT continues its support to Malians and their fellow African farmers. "To face the oncoming challenge of climate change, future generations will need further help from the research done by ICRISAT to adapt. They will need more resistant varieties adapted to drought and aflatoxin. Varieties like ICGV 91317 will be more than necessary," he concludes.