ICRISAT

New Horizons of Scientific Excellence for the Semi-Arid Tropics

Annual Report 2007

International Crops Research Institute for the Semi-Arid Tropics


CGIAR




Meeting
Improvement
(ICAR)


New Horizons of Scientific Excellence for the Semi-Arid Tropics

Contents

Cover: Aerial view of ICRISAT Headquarters, Patancheru, India

Message from the Director General

We are happy to report some of ICRISAT's achievements in this past year – achievements that take us closer to our goal and vision of bringing about the well-being of the poor in the semi-arid tropics.

The stories we report this year reveal elements of novelty in technologies, trends, and approaches that we have employed towards making science work for the poor. The super-early chickpea will help farmers avoid the end of season drought, and our scientists are on the threshold of developing the nutrient-rich pearl millet we have pursued for years.

In June this year the VOA reported the saving grace of pigeonpea in Kenya, giving credit to ICRISAT for the research and development of this precious legume. An ex-scientist of ICRISAT commented on the VOA report saying, " Pigeonpea demonstrated its superiority during a severe drought – several families we visited survived solely on pigeonpea as it was the only crop that made it in the fields." Our story on commercialization of pigeonpea in eastern and southern Africa highlights the success that pigeonpea brought to the region.

In the Sahel, problems outrun solutions, but innovations of ICRISAT and partners bring hope to the seemingly hopeless, as demonstrated through our story on reclamation of saline lands in Senegal. To quote a National Geographic report from 1987, "If there is to be a savior for agriculture in the Sahel, I nominate ICRISAT." Twenty years from then ICRISAT is still gaining ground and saving lives through agricultural innovations.

Our efforts against crop diseases are illustrated in the story about overcoming the dreaded blast disease of finger millet on one hand, the story about using high tech science to render the *Striga* weed ineffective, and in the story about the new and very much in demand aflatoxin laboratories that ICRISAT has set up in 17 locations of India and sub-Saharan Africa.

This year, more than any other, our sweet sorghum varieties have grabbed global attention for the bioethanol they can produce. A diverse use of sweet sorghum is reported in the story about feed blocks for livestock – a joint effort by ICRISAT and the International Livestock Research Institute.

ICRISAT's ultimate beneficiary is the poor farmer of the semi-arid tropics. Members of our Insitutions, Markets, Policy and Impact group are continually studying the lives and livelihoods of village dwellers, as you will glean from the story of the Village Level Studies in six villages.

ICRISAT's work has made many impacts, but we must give due credit to our excellent team of scientists, support staff and donors for making this possible together with our partners. I also gratefully acknowledge the guiding role of our Governing Board in achieving our mission.

William D Dar
Director General

Message from the Chair

This has been a year of exceptional achievement for ICRISAT. Through an ever-expanding network of partnerships, the results of our research have made a significant contribution to improve the livelihoods of the poor in the semi-arid tropics. Our research pipeline has continued to strengthen to ensure our strategic position in meeting the emerging challenges of this uniquely fragile environment for which we are responsible within the CGIAR.

Research is a long-term and intrinsically risky undertaking. The challenge of building and sustaining robust institutions that will successfully conduct this, is equally demanding. It is therefore gratifying that the very positive results of nearly a decade's teamwork by ICRISAT's Director General, Dr William Dar, the Governing Board, its management team and staff are being widely recognized both within the CGIAR System and its stakeholders.

Evidence of this includes:

- ICRISAT was one of only two rated as "outstanding" by the CGIAR among 15 Centers.
- Investment by donors into ICRISAT has continued to increase and in 2006, the Institute achieved its second highest level of expenditure (US$34.1 million) since its inception.
- Dr William Dar has been nominated by the Philippine government and elected as Chair of the UNCCD's Committee on Science and Technology - a well-deserved honor. This position will link the Alliance of CGIAR Centers to this prestigious scientific body.
- ICRISAT is the co-leader with ICARDA of a potential new desertification Challenge Program (CP), which is one of only three short-listed for further development by the Science Council. This builds on years of groundwork by Team ICRISAT to develop the 'Oasis' initiative, which, if successfully adopted as a new CP, will be subsumed within it.
- ICRISAT is a core partner in both the other two Challenge Programs on high-value crops and climate change, which are also under development.

I profoundly thank all of ICRISAT's staff and stakeholders for supporting our work in 2006. ICRISAT is in good shape to achieve its mission and is more committed than ever to delivering this amidst emerging global challenges to international agricultural research.

Simon G Best

Simon G Best, FRSE
Chair
ICRISAT Governing Board

Pursuing the Super-Early Chickpea

Scientists examine the early-maturing variety ICCV 2 in Tanzania.

Chickpea [*Cicer arietinum*] is grown in over fifty countries in a wide range of environments and cropping systems. An important component to be considered for crop adaptation to the different environments is phenology (the time to flowering, podding and maturity). Chickpea can mature in a wide timeframe ranging from 80 to 180 days depending on the genotype, growing conditions and environment. However, in at least two-thirds of the chickpea growing areas, the available crop-growing season is short (90-120 days) due to risk of drought or temperature extremities towards the end of crop season, which coincides with the pod filling stage of the crop. So, in order for the crop to escape stress at the end of the season, it is important to cultivate early maturing varieties for these areas.

Chickpea is largely grown on receding soil moisture after the rains. Terminal drought and heat stresses are the major abiotic constraints it faces in the semi-arid tropics, where it is grown in rainfed conditions. Terminal drought is also a major constraint in autumn-sown rainfed crops in Mediterranean-type environments (as in Australia). Early maturity is also important for the summer-grown crop in temperate environments (as in Canada) as the crop often encounters end of season frost.

India is the largest chickpea growing country with over 60% share in the chickpea area. During the past four decades, the chickpea area declined by 3.2 million ha in northern India (cooler long-season environments) and increased by 2.5 million ha in central and southern India (warmer short-season environments), thus further necessitating cultivation of early maturing varieties. The chickpea area under late sown conditions is increasing in many chickpea growing areas, particularly in northern India due to increase in cropping intensity and late harvesting of the preceding crop. Other areas that could be used for chickpea cultivation are those that remain fallow in the winter season after harvest of rainy season rice (about 14.0 million ha in South Asia). Early maturing varieties would be needed in all these late sown conditions.

Development of early maturing varieties is one of the major objectives of ICRISAT's chickpea breeding program. ICRISAT and the national agricultural research system (NARS) partners developed many early maturing, high yielding and fusarium wilt resistant varieties of desi and kabuli chickpea. Adoption of these varieties has led to increase in area and productivity of chickpea in short-season environments, for example, in central and southern India and in Myanmar. The first landmark variety was ICCV 2, which is perhaps the world's earliest maturing variety of kabuli chickpea. It flowers in about 30 days and matures in about 85 days at Patancheru near Hyderabad. It has been released for commercial cultivation in India, Myanmar and

Sudan, and has spread to many other countries, including Tanzania. It has been instrumental in extending kabuli chickpea cultivation to tropical environments, and presently covers over 50% of the chickpea area in Myanmar.

Further advancements were made in breeding for earliness in chickpea. Two super-early desi varieties ICCV 96029 and ICCV 96030, were developed that mature in 75 to 80 days in southern India. These lines provided further opportunities for expansion of chickpea cultivation in new niches. Scientists conducted several experiments on super early lines to see if these were suitable for cultivation in northern India for use as a vegetable (immature green grain as vegetable). The farmers, especially marginal farmers, prefer to grow early podding cultivars as a vegetable, as early delivery to the market fetches a higher price. The experiments showed that super-early chickpeas could be grown after harvest of rice and before planting of wheat as a short duration catch crop for use as a vegetable. This short duration crop will provide extra income to farmers and inclusion of a legume (chickpea) in a rice-wheat cropping system will have beneficial effects on productivity and long-term sustainability of the cropping system. However, the currently available super-early lines, particularly ICCV 96029, need improvement for resistance to fusarium wilt and seed size, so current breeding efforts are focused on improvement of these traits.

Efforts have also been made to identify new sources of earliness. It was found that the major early flowering gene present in ICCV 2 (also in ICCV 96029) was different from that present in ICC 5810 (Harigantars). A new early flowering gene was identified from ICC 16641 and ICC 16644. Thus, three major genes were identified for early flowering. These discoveries will improve precision and efficiency of chickpea breeding for desired maturity.

We have succeeded in improving fusarium wilt resistance and seed size of super-early lines. Progenies have been developed that are as early as the super-early parent ICCV 96029 and have a high level of resistance to fusarium wilt, with a seed size similar to that of ICCV 2. There are several other lines that mature even a week earlier than ICCV 96029, which look very promising to scientists on the super-early mission.

Farmers, especially in the short-season areas, can now be assured of super-early chickpeas with acceptable seed size and resistance to fusarium wilt in the not too distant future.

Director General Dar and senior scientists compare the early variety to the traditional varieties surrounding the plot.

Managing Blast in Finger Millet

Blast (*Magnaporthe grisea*), the most serious and widely spread disease of finger millet, affects the crop at all growth stages. It causes lesions and premature drying of young leaves. Blast can also affect the whole panicle or just a few fingers, preventing the grain from setting or causing the seeds to shrivel. Though farmers are aware of the disease and its impacts on finger millet productivity, none of them know of an efficient coping strategy. The use of cultural (uprooting and burning infected plants) and chemical options to mitigate the effects of blast, though plausible, is limited by efficiency and cost implications. However, growing blast-resistant varieties of finger millet is a better, more cost-effective method of blast control; ICRISAT has been working on developing these varieties.

From 2001 to 2004, ICRISAT, the Serere Agricultural and Animal Husbandry Research Institute (SAARI) in Uganda and the Kenya Agricultural Research Institute (KARI) conducted a study funded by the British Government's Department for International Development (DFID) on the pathogen diversity and management of blast. Results revealed limited diversity among the populations, though there was a considerable range of aggressiveness of the pathogen. The study also screened and identified 14 finger millet varieties that were resistant/tolerant to blast and suitable for growing in Uganda and Kenya.

The effects of blast – poor grain setting and shriveled grain.

Experimental design: The mother/baby approach

In 2005 and 2006, ICRISAT, SAARI and KARI partnered up once again. This time they used the mother/baby trial design to evaluate resistance to blast and farmer perceptions on improved finger millet varieties in western Kenya and Uganda (Figure 1).

The mother/baby approach involves establishing 'mother' trials, which are completely managed by researchers and replicated two to four times per site. These trials are designed to compare different 'best bet' technologies in the same field both in the same season and also over several years.

The 'baby' trials are located around the mother trial. Farmers are allocated carefully selected treatments from the mother trial to test on their individual farms. These trials are not replicated. Baby trials provide farmers an opportunity to observe first hand the performance of treatments at different trial sites and allow for faster, larger-scale testing at different locations under different management conditions. Put together, the mother and baby trials provide a data set that is a good mix of variables and allow for comparison of farmer practice with researcher-managed trials that vary over time and space.

The mother/baby trials then tested those previously identified varieties in selected villages in three and four districts of Uganda and Kenya respectively. Each mother trial consisted of one local and seven improved varieties. One of the seven improved varieties was a commercial variety. Each baby trial consisted of four of the above-mentioned varieties including a farmer's local check and the commercial variety.

The mother trials provided data on blast on the leaf, neck and fingers of the crop, days to 50% flowering, Finger millet facts

- Finger millet (*Eleusine coracana*) originated in the highlands of eastern/central Africa from where it moved to the Indian subcontinent around 3000 BC.
- Finger millet accounts for 8% of planted area and 11% of the production of all millets worldwide.
- In Eastern Africa it is grown mainly in the lake regions and highlands of Burundi, Democratic Republic of Congo, Kenya, Rwanda, Tanzania, and Uganda.
- Finger millet has a high production potential, reaching up to 4 t/ha under optimum conditions. However, average grain yield on farmer's fields are low, ranging from 500 kg/ha to 750 kg/ha.
- Rich in calcium, iron, manganese and fiber, finger millet is known for being more nutritious than other cereals. It is an excellent source of methionine, an amino acid often lacking in the diets of the millions of poor who live on starchy foods such as cassava, plantain, polished rice and maize meal.
- Finger millet can be stored for long periods without being attacked by insects or mold, a critical trait in ensuring food security for poor households in drought-prone areas.

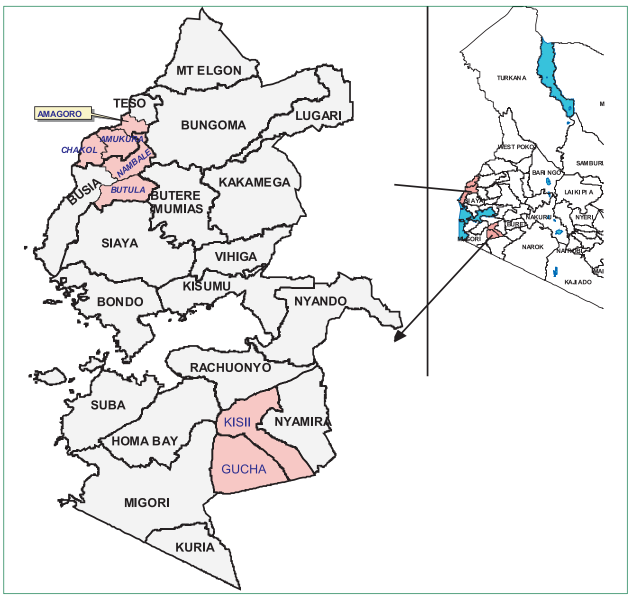

Figure 1: Trial sites in Kenya for the 5 mother and 81 baby trials.

agronomic scores, plant height, lodging, panicle weight, threshing percentage, 100 g seed mass and grain yield. The data were analyzed for each mother trial and also combined across sites. The results of the study were used to assess farmers' preferences and determine which varieties with high productivity and low reaction to blast on farmers' fields were suitable for western Kenya and Uganda.

Identifying varieties for districts

Overall, Dr Mary Mgonja, Principal Scientist at ICRISAT, and her team of breeders found that the average yield from the baby trials (1.52 t/ha) was almost the same as the average yield from the mother trial (1.58 t/ha) in Kenya. This showed that, in general, farmers managed their fields just as well as the researchers did. In Uganda, the improved varieties with a mean grain yield of 2.55 t/ha were much superior to the local varieties that yielded 1.45 t/ha. The farmers rated the varieties based on various traits such as the size of the panicle, yield, resistance to blast, and the color of the grain (most farmers preferred brown). The study found that in Kenya the varieties KNE688, KNE1149, KNE814 and Acc14 were suitable for Busia and Teso districts whereas varieties KNE 814, KNE 688 and Acc14 were suitable for Kisii and Gucha districts. In Uganda varieties Seremi 1, Seremi 2 and SX 8 were selected for their blast resistance and productivity.

Besides identifying suitable varieties, farmers were also able to learn methods of integrating appropriate agronomic practices to improve productivity. They identified methods of postharvest handling to increase grain quality and cleanliness, and ultimately improve market value for their product.

ICRISAT is working closely with the NARS partners, large, medium and small processors and the seed industry to facilitate easy access to disease-resistant varieties, promote knowledge sharing to enhance productivity and create better links to markets in order to improve food and nutrition security and ultimately put more cash in farmers' pockets.

TV Dinners for Livestock?

Poor livestock keepers in the semi-arid tropics point to feed shortages as one of their biggest animal production constraints. Crop residues provide fodder from the cropping system without need for additional resources such as arable land and water, as is often the case with planted forages. Crop residues already constitute over 40% of India's feed resources, and their importance is likely to increase.

Surveys of sorghum stover fodder markets in Hyderabad, India, have shown that stover from grain sorghum is widely traded as livestock fodder, sourced from several Indian states and transported over distances of more than 350 km. The stover fetches retail prices that are about half the value of the sorghum grain, ranging from Rs 3.1 to 3.9 (approximately 10 US cents) per kilogram of dry stover, with higher quality stover fetching premium prices. Stover digestibility was found to be highly correlated with stover prices, and the price difference was associated with about 5 units (%) difference in digestibility (47 to 52%).

Recognizing the importance of crop residues as livestock fodder, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the International Livestock Research Institute (ILRI) embarked on collaborative efforts to improve the fodder value of crop residues at source through multidimensional plant breeding and selection. The collaboration has shown that nutritionally important differences, such as the 5% difference in digestibility, can be exploited in most rainfed crops without detriment to grain/pod yields.

Yet, crop residues do not promote desirable levels of livestock productivity without being supplemented with higher quality feed components. Miracle Fodder and Feeds Pvt Ltd in Hyderabad produces a sorghum stover-based feed block according to the Total Mixed Ration principle that provides a nutritionally balanced diet. The stover is compacted in the block, thereby increasing its transport and storage worthiness. The block weighs 15 kg and costs Rs 90. It feeds one dairy animal/day with a production level of 8 to 12 liters of milk/day.

Most recently the ICRISAT-ILRI collaboration has engaged with Miracle Fodder and Feeds to explore value addition to their sweet sorghum. Sweet

An Indian farmer feeding his livestock with a feedblock made from sweet sorghum residues.

Sorghum stover being carted to market.

sorghum is well adapted to the semi-arid tropics. Farmers use it as a multi-purpose crop, getting grain for human consumption and livestock feed from the stover. Today, sweet sorghum is becoming increasingly used in industrial bio-fuel production in India. It is one of the most viable alternatives for the production of ethanol. While the sale of sweet sorghum stalks to distilleries can be an income source for dryland farmers, its sale diverts biomass away from the farmers' livestock, until arrangements can be made to return the bagasse (the stalk residue after extracting the juice) to livestock growers. The bagasse together with stripped leaves could compensate for some of the fodder loss.

Laboratory analysis of the fodder quality of bagasse and leaf residues from a wide range of sweet sorghum varieties and hybrids showed promising results. However, promising laboratory fodder quality indices do not necessarily correlate positively with palatability (ie, feed intake) for livestock, particularly in unconventional feedstuffs such as bagasse. To address this issue, scientists compared the feed intake and live weight gain of cattle fed with sweet sorghum bagasse plus leaf stripping with the commercial feed block (CFB). In the experimental feed block (EXFB) all sorghum stover was substituted for by sweet sorghum bagasse plus stripped leaves.

It was promising to observe that there was no (statistical) difference in feed intake between the CFB and the EXFB. For both blocks the voluntary dry matter feed intake was high at 3.5% (CFB) and 3.7% (EXFB) of the animals' live weight. Intakes of crop residues by non-lactating livestock are commonly 2.5% or less of live weight. It is worth noting that intake of sorghum stover when fed alone was only 1.3% of live weight, while intake of stover as part of the CFB amounted to 1.75% of live weight. These findings underline the importance of balanced supplementation in optimizing the utilization of crop residues for livestock production. Scientists found no significant difference between the daily live weight gain of the bulls fed CFB (0.82 g) and the bulls fed EXFB (0.73 g), which confirms the value of bagasse plus stripped leaves as feed block ingredients.

Feeding of CFB and EXFB would result in the daily production of 8.4 and 8.2 liters of fat rich milk, respectively. The income from milk would depend on the going rates. For example, in Hyderabad the rate is currently Rs 22 to Rs 28 per liter of fat rich buffalo milk. Taking an average value of Rs 25 per liter, the revenue from milk, feeding one unit of CFB, would be approximately (8.4 x 25) Rs 210 per day and feed costs would be Rs 90. For the EXFB-fed, it would be approximately (8.2 x 25) Rs 205. However, feeding costs could be lower if sweet sorghum bagasse plus leave strippings were purchased at less than Rs 2.40 to Rs 2.80 per kg, which is the price Miracle Fodder and Feeds now incurs for the sorghum stover.

At the moment optimization of the various components is still in progress. Ultimately this should result in better livelihoods for both the farmers and the livestock owners.

The Making of the Micronutrient-rich Pearl Millet

According to a WHO report of 2002, micronutrient malnutrition, resulting from deficiency of important minerals such as iron (Fe) and zinc (Zn), is a massive global problem, afflicting over 3 billion people worldwide (over half the world's population), mostly women, infants and children in resource-poor families of the developing countries. Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is a major warm-season cereal grown on 26 million ha in some of the most marginal arid and semi-arid tropical environments of Asia and Africa. Pearl millet is a nutritious cereal with high levels of protein (12%), energy (3600 K cal kg^{-1} grain) and a balanced amino acid profile – a major source of dietary energy for more than 90 million people in these environments and the cheapest source of grain Fe and Zn.

The HarvestPlus initiative of the CGIAR has recently embarked upon addressing the micronutrient malnutrition problem through the development of cultivars with elevated levels of grain Fe and Zn in several crops, including pearl millet. A study under this project showed large variability for grain Fe (30 to 80 mg kg^{-1}) and Zn (24 to 65 mg kg^{-1}) among a diverse range of populations, breeding lines and germplasm accessions.

Among the open-pollinated varieties, ICTP 8203, a popular commercial variety derived from the *iniadi* landrace and grown on 0.3 million ha in India, recorded the highest grain Fe (80 mg kg^{-1}) and Zn (47 mg kg^{-1}) with early-maturity, large seed size and resistance to downy mildew. Another variety, GB 8735, again developed largely from the *iniadi* germplasm, and released in several countries in western Africa, also had high Fe (63 mg kg^{-1}) and Zn (53 mg kg^{-1}). Among the hybrid parents, 863B had the highest level of Fe (73 mg kg^{-1}) with high Zn content (56 mg kg^{-1}). Incidentally, 863B is also from *iniadi* germplasm with large seed size, early maturity and drought tolerance, and it is the seed parent of three commercial hybrids developed by private seed companies and grown in India.

ICTP 8203, a large-seeded variety with high Fe and Zn content, seen here in a farmer's field in southern India.

The highest levels of Fe and Zn content were observed in large-seeded and well-adapted commercial varieties and in the parental lines of released hybrids, which had a large *iniadi* germplasm base in their parentage. While comparing some of the recent reports of other crops, it was generally observed that the high grain Fe and Zn content found in pearl millet is almost 40-50% more than those in cultivated maize and wheat varieties. The pearl millet studies also showed large within-population variability of over two-fold for grain Fe

(41-119 mg kg^{-1}) and Zn content (32-83 mg kg^{-1}) detected in progenies derived from two open-pollinated varieties (AIMP 92901 and ICTP 8203) released in India and GB 8735 released in Africa), suggesting the prospects of developing improved versions of these (as well as other) commercial open-pollinated varieties with high Fe and Zn levels by utilizing intra-population variability, and without compromising on grain yield and other important agronomic traits (Figure 1).

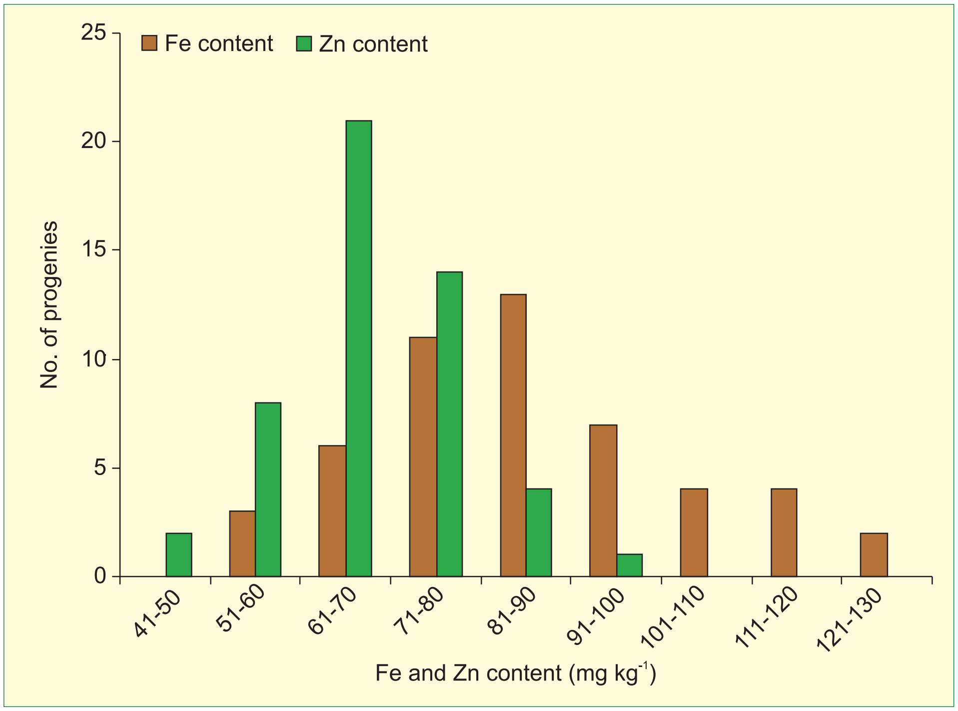

Figure 1. Frequency distribution of ICTP 8203 (S1) progenies for grain Fe and Zn content.

Highly significant and positive correlation between Fe and Zn found in several trials suggested that simultaneous genetic improvement for both the micronutrients should be effective. Also, highly significant positive correlations of grain Fe and Zn with 1000-seed weight, or lack of any correlations indicated that breeding for higher levels of these micronutrients could be achieved without compromising on large seed size. Thus, prospects are good for developing high-yielding open-pollinated varieties and parental lines of potential hybrids with high grain Fe and Zn contents.

Despite some degree of genotype × environment interaction, mineral traits (Fe and Zn) are generally stable across environments. The relative ranking of the genotypes for grain Fe and Zn content followed similar patterns when tested across years and at the varying soil Fe and Zn levels at Patancheru near Hyderabad. However, since environment, especially the type of soil, has a strong influence on mineral content of grains, there is a need to validate these identified materials for stability of grain Fe and Zn across diverse soil types and soil fertility levels.

Research on genetics of Fe and Zn content showed that these are largely governed by additive gene action, and thus results in low levels of heterosis. None of the hybrids exceeded the better-parent that had high Fe and Zn levels, indicating that it would require the breeding of both seed parents and restorer parents with high Fe and Zn content to produce hybrids rich in these micronutrients. This is because the favourable alleles (alternate forms of the gene) come from high Fe and Zn lines. These alleles are more often of the recessive nature with increasing effects on the grain Fe and Zn content. Therefore, incorporating genes responsible for high Fe and Zn contents in high-yielding lines that would be involved as parents of open-pollinated varieties, or of hybrids, either through pedigree breeding or backcross breeding (using marker-assisted selection) is the logical approach to develop high-yielding cultivars with high levels of grain iron and zinc contents in pearl millet.

This rings of hope for the malnourished millions of the semi-arid tropics, and points out the need for sustained research on genetics and breeding of these micronutrients, using high science tools.

Commercialization of Pigeonpea Spells Prosperity

Farmer Priscilla Mawewu of Emali village showing off the green pigeonpea she cultivates.

Pigeonpea (*Cajanus cajan*) is one of the most important food crops grown in eastern and southern Africa. Farmers love this crop for many reasons – tolerance to drought, important source of protein for the family, vital source of scarce cash, and provider of fodder for livestock. Pigeonpea fixes soil nitrogen, allowing the poor farmers to improve soil fertility without expensive chemical fertilizers. Farmers have evolved elaborate intercropping systems allowing them to plant pigeonpea with maize, sorghum and other cereals making it highly suited to semi-arid, low soil fertility areas.

African farmers have not been able to fully exploit the potential of pigeonpea because: (a) local varieties are low yielding and susceptible to pests and disease; (b) some of the available varieties were small-seeded and did not meet market requirements; (c) market linkages for dryland farmers are largely underdeveloped; and (d) available market and farmer-preferred varieties did not reach farmers due to poor input and technology delivery systems.

These factors have made it difficult for African smallholders to benefit from the sizable export market. India alone imports over 254,000 tons of pigeonpea per year, but Africa supplies less than 5% of this demand. There are similar high value niche markets for exporting to European and American markets. Meanwhile, the domestic demand for pigeonpea has been growing substantially over the last few years, increasing the wholesale prices where overall production is limited.

ICRISAT and partners have been working to develop suitable varieties and institutional innovations to help African dryland farmers benefit from the crop. This began with the development of large-seeded, cream colored and fusarium wilt resistant varieties, and partnerships with the private and public sector institutions to address constraints in output marketing and utilization. This has catalyzed a process of livelihood transformation for many dryland farmers in Kenya, Tanzania, Malawi and Mozambique. The increasing availability of improved varieties along with institutional innovations enable farmers to reduce the costs of product marketing, spurring commercialization of the crop.

In northern Tanzania, improved varieties such as ICEAP 00040 and ICEAP 00053 are becoming very popular. In Babati district – famous for quality pigeonpea production – adoption levels have reached 60% and pigeonpea alone contributes more than 50% of the cash incomes for smallholder farmers. Realizing the huge demand for improved seeds, local agro-dealers (called agrovets) contract trained farmers to grow high quality seeds with the support of the extension system in training and organizing farmers. The produce is marketed through producer marketing groups (PMGs) that allow smallholders to benefit from collective action.

In Kenya, the pigeonpea revolution was ignited through an ICRISAT-led consortium that brought together parties like TechnoServe, CRS, KARI and private sector processors and exporters. Successive projects for legume commercialization stimulated local seed production and agro-dealer networks for distribution and marketing. The PMGs facilitated community seed production, local distribution and market access, and managed to increase local producer prices by 20-25% in Nairobi and Mombassa after linking to wholesalers.

This is making tangible gains for poor farmers in these areas where maize has traditionally been the main crop for a long time. Unfortunately, the maize crop fails in three out of five years, leaving families to rely on pigeonpea – widely considered as a lifesaver and guarantor of livelihoods in these drought-prone areas.

The first improved varieties reached farmers of Emali village (Makueni district, Kenya) around 2003 through field days held at the ICRISAT/KARI research station in Kiboko. Enterprising women farmers took the lead in demonstrating the pigeonpea technology and proudly call it "our dryland coffee!", they also call it "our beef", alluding to its high protein content. These farmers have also realized the potential of fresh vegetable pigeonpea in the domestic market. The pigeonpea matures when food reserves are low, making it a popular crop to stave off hunger. Thanks to this high local demand, most of the pigeonpea grown is now being sold as green peas at prices almost twice that of the dry grain.

Jane Mulinge, a mother of eight children, sold over 1 ton of vegetable pigeonpea during 2007 at a price of 20-30 Ksh/kg. She plans to expand production from 4 acres to 6 acres in the next season. Priscilla Mutie, another innovator and single mother in the community, planted 5 acres during 2007 and sold over 1.5 tons of fresh pigeonpea since March 2007 at 25-30 Ksh/kg. Her increased income helps support a family of eight, including orphan children. Priscilla also maintains a village shop where she sells to "fellow farmers who have not mastered the art of growing high value crops". She plans to expand production to 10 acres. When interviewed on her mobile phone, she said, "I assure you that I won't plant maize again. I have proudly learned that one bag of pigeonpea can buy two bags of maize."

The commercialization of pigeonpea is allowing farmers to own valuable assets ranging from mobile phones to productive land and livestock, and is opening viable pathways to move out of poverty. Several farmers have invested in small ruminants, milking cows and bullocks, helping them expand income sources, reduce vulnerability and mechanize production. This has also increased school enrolment as families can now afford to send more children to school. The increased income also allows families to improve food security and increase expenditure on other basic needs to improve the quality of life.

Kathouzweni marketing group displaying prices from different markets.

Multiplying the Mycotoxin Laboratories

Mycotoxins are fungal poisons that contaminate up to 25% of human food and causes losses ranging from $0.5 to 1.5 billion in the USA alone. Among various mycotoxins, aflatoxins, produced by *Aspergillus flavus* and *A. parasiticus*, occur globally. Research reports indicate that aflatoxin contamination is widespread in staple crops such as groundnut, maize, sorghum, pearl millet, chillies, pistachio, cassava, and even in milk from animals fed with contaminated feed. They are carcinogenic, teratogenic and immunosuppressive natural toxins that are implicated in growth retardation in children, immune-suppression, interference in micronutrient metabolism, liver cirrhosis, liver and esophageal cancers, and decreased human and animal productivity.

Principal Scientist Farid Waliyar displaying aflatoxin quantification using the ELISA reader.

Acute intoxication of aflatoxin can result in death. Maize contaminated with aflatoxin was the reason for the deadly aflatoxicosis epidemics in Kenya three times since 1981. In 2004, Kenya suffered an outbreak of acute hepatotoxicity with 317 cases and 125 deaths, making this one of the largest and most severe outbreaks of acute aflatoxicosis documented worldwide. The outbreak was the result of aflatoxin poisoning from ingestion of contaminated maize. Mycotoxins have a synergistic effect with Hepatitis B & C viruses; aflatoxin is 30 times more potent in persons with Hepatitis and the relative risk of cancer increases between 5 and 60 fold when Hepatitis B patients are exposed to aflatoxin contamination.

Mycotoxins can cause severe and sudden anorexia, convulsive movements, feed refusal, loss of weight, reduced egg production and milk contamination in poultry and livestock. ICRISAT, CGIAR and FAO, recognize the economic and health implications of aflatoxins as an important constraint to the improvement of human health and well-being through agriculture, and pursue various strategies to eliminate aflatoxin contamination in food and feed. Aflatoxin contamination of agricultural commodities has gained global marketing significance due to the strict trade restrictions in countries where acceptable levels range from 0-35 µg/kg. To avoid the aflatoxin contamination in the food chain, thereby mitigating hazardous effects on human and livestock health, it is essential to test the food products for mycotoxins before they are consumed and it also demands more aflatoxin testing laboratories with cost effective technology.

Aflatoxin contamination, besides being sometimes invisible, affects food quality and has grave food safety concerns. In developed countries, aflatoxins are regulated through good production and post-harvest practices, and stringent food safety monitoring. However, application of such strategies in the developing countries are not easy due to differences in production practices, food deficiency, lack of resources and technology for monitoring and, more than anything, poor awareness about the problem. Consequently, people in these countries are chronically exposed to aflatoxins. Moreover, warm humid or drought conditions in less developed countries favor the proliferation of the mold fungi and subsequent aflatoxin production. It is vital that we be able to detect and quantify aflatoxins in commodities to protect human and animal health. Many different methods, including antibody-based ones, are available for quantitative estimation of aflatoxins. However, most of these methods are expensive, laborious, time consuming and require extensive sample cleanup.

Aspergillus flavus *infected groundnuts.*

Using the state-of-the-art facilities at ICRISAT, we produced polyclonal and monoclonal antibodies for the detection of total aflatoxins, aflatoxin B1 and M1 (secreted in milk) ochratoxins and fumonisin. These were used to develop a simple and inexpensive competitive enzyme-linked immunosorbent assay (cELISA) that has a lower detection limit of 1.0 µg/kg and costs less than $1 per sample – the cheapest in the world. The results obtained using cELISA are comparable with that of highly sensitive high performance liquid chromatograph (HPLC) results. This assay is simple to perform, requires minimum laboratory facilities and most of the chemicals are available locally.

This cELISA test provided a unique opportunity for ICRISAT and its partners to conduct field studies to select breeding populations and to discover dietary sources of aflatoxin, thereby stimulating interventions that enhance safety of food and human health, trade, and ultimately farmers' income. Responding to the increasing demand for more testing facilities, ICRISAT helped in setting up 17 aflatoxin-monitoring laboratories in India, Mozambique, Kenya, Malawi and Mali where our cELISA technology is used. Local personnel were trained to manage the facility. The diagnostic reagents are widely distributed to partners in Asia and sub-Saharan Africa (SSA). These laboratories contribute to the quality certification of the farmers produce and enhance the competitiveness of the produce in domestic and international markets. For instance, the National Small Farmer Association of Malawi (NASFAM) and ICRISAT have established collaboration for testing the groundnut produced by the farmers. Based on the level of aflatoxin contamination, NASFAM graded groundnut lots into permissible (<4 $\mu g\ kg^{-1}$ or <20 $\mu g\ kg^{-1}$) and non-permissible grades (>20 $\mu g\ kg^{-1}$). Graded groundnut lots found favorable markets for regional and global export, benefiting the farmers. The aflatoxin-testing laboratory in Malawi contributed to the revival of groundnut exports to Europe and South Africa from that country.

ICRISAT is planning to further upscale aflatoxin testing facilities to strengthen the local capacity for aflatoxin monitoring in SSA and Asia. Measures like these will yield favorable results to farmers, contribute to the production of aflatoxin-free food and enhance regional and international trade opportunities.

Stifling *Striga* with Stronger Sorghum

Sorghum [*Sorghum bicolor* (L.) Moench] is the 5th most important cereal crop worldwide. The plant is mainly cultivated in dryland areas of Africa and Asia, and also in the Americas. Average grain yields range from 800 kg ha^{-1} in Africa to 3400 kg ha^{-1} in America. Parasitic weeds of the genus *Striga* are the major biotic constraint to agricultural production in sub-Saharan Africa. *Striga hermonthica* and *Striga asiatica* parasitize mainly cereals. Yield losses can, especially in the presence of additional drought stress, attain 100%. In comparison with chemical, mechanical and biological *Striga* control methods, the cultivation of crop cultivars resistant to *Striga* is of particular advantage to farmers, since it does not require specific investments in materials or labor.

Ismail Rabbi, a PhD student registered at Hohenheim University, working in the ICRISAT/BecA laboratory in Nairobi. (Inset: Sorghum affected with Striga.*)*

Although genetic variation for *Striga* resistance in sorghum was identified as early as 1933, progress made via classical breeding had been slow. There was insufficient comprehension of the inheritance of *Striga* resistance, lack of easy and fast laboratory resistance tests, and difficulty to produce reliable field data. However, in the last 10 years, ICRISAT and the University of Hohenheim have made significant progress in identifying molecular markers for *Striga* resistance in sorghum. During this period, five genomic regions (called quantitative trait loci or QTL) associated with stable *Striga* resistance from resistant line N13 were identified across a range of 10 field trials in Mali and Kenya. The QTLs were identified on different chromosomes and each of these QTLs explains between 14 and 44% of the total phenotypic (outward appearance) variation observed for *Striga* resistance in the sample used. Flanking SSR (simple sequence repeat) markers to the QTLs are now available for use in marker-assisted backcrossing and they are vital in transferring *Striga* resistance from the donor N13 to susceptible farmer preferred sorghum varieties (FPSVs).

Through a consortium involving ICRISAT, University of Hohenheim, NARS in Kenya, Eritrea, Sudan and Mali using the Biosciences for eastern and southern Africa (BecA) platform for genotyping (related to the genetic makeup of an organism), a project entitled, "Arresting the Scourge of *Striga* on Sorghum in Africa by Combining the Strengths of Marker-Assisted Backcrossing and Farmer-Participatory Selection", was developed three years ago with funding from the Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwickling of Germany (BMZ). The aim of the projects is to develop near-isogenic (having identical genes) FPSVs carrying one to three *Striga* resistance QTLs using a combination of marker-assisted backcrossing and farmer-participatory selection. Simultaneously, studies are undertaken to enhance the understanding of sorghum seed supply systems and to ensure the effective integration of seven *Striga*-resistant FPSVs into farming systems in Eritrea, Kenya, Mali and Sudan. The extent of outcrossing rates and gene flow are being determined in five selected FPSVs. This will help to derive recommendations for maintaining *Striga* resistance in the near-isogenic FPSVs during seed production. The seed supply systems and outcrossing studies are being undertaken by two PhD students registered at the University of Hohenheim in Germany.

The success of the project relies on the effective utilization of the BecA platform for genotyping activities. The concept of BecA as a technology platform and network was initiated in 2002, with an allocation of Cdn$ 30 million from the Canadian International Development Agency (CIDA) through the NEPAD's Canada Fund for Africa. The BecA platform is open for advancing applied science in Africa through partnerships with all qualified institutions and individuals, and it focuses on projects helping to resolve high-priority problems (such as the *Striga* menace), identified by national and regional organizations. ICRISAT, with its mandate to expand its activities in Africa, is already using the facility to advance the activities of the *Striga* project, particularly genotyping and training of the NARS partners.

The project has now genotyped several hundred plants from two backcross generations using a total of 10 foreground SSR markers aimed at identifying plants heterozygous for one to three *Striga* resistance QTLs and 16 background SSR markers with the aim of speeding up recovery of the recurrent parent. Genotyping revealed that 256 plants from the second backcross generation (BC_2F_1) were heterozygous for one to three QTLs that represent all the four linkage groups.

In Kenya, 43 BC_2F_1 plants were self-pollinated and genotyped to select for segregating homozygous BC_2S_1 plants that have been taken through another selfing generation (BC_2S_2) to fix the QTLs. Plans are now underway to select and multiply BC_2S_2 plants containing one to three QTLs and also have good farmer preferred variety phenotype for evaluation of *Striga* resistance in artificially infested fields. In Mali and Sudan, plans for genotyping the BC_2S_1 are now underway. This will be followed by self-pollination to fix the QTLs and subsequently field trials after seed increase. Preliminary studies have revealed some variability in FPSVs with outcrossing rates ranging between 5-20%. Initial gene flow studies have shown pollen dispersal for distances of up to 100m in multiple directions, with a marked decrease after 40m from the center.

For those of us unfamiliar with genetics, suffice to say that biotechnologists are applying new science to overcome an old weed menace. Stifle the weed's effectiveness, and farmers (not to mention the sorghum) can breathe easier!

Scientists in a sorghum gene flow field experiment in Kiboko research station, Kenya.

Reclamation of Saline Acid Soils in Senegal

Background

Salinity is a big threat to agriculture and the environment of Senegal in West Africa. In this country one can distinguish three separate processes of salinization:

1. Salinization resulting from over use of irrigation water coupled with lack of appropriate drainage. Over irrigation results in the creation of a shallow water table. Water rises to the soil surface by capillary movement. The water then evaporates leaving the salt on the soil surface. This type of salinization is prevalent in the irrigated lands alongside the Senegal River.
2. Salinization of over utilized coastal aquifers caused by sea water intrusion, and
3. Salinization by seawater that moves inland along tidal rivers, spills over into the rivers' effluents and salinizes the shallow ground water. Due to the low elevation of Senegal's coastal zones, ocean tides can flow more than 100 km up river. Saline water rises to the soil surface by capillary forces, evaporates and the remaining salts accumulate on the soil surface. The saline soil profile is typified by a low pH (4-5) resulting from anaerobic oxidation of organic matter.

Salinized soils in the Saloum basin, Senegal.

Soil salinization alongside the tidal rivers was accelerated in the drought years of the seventies and by the destruction of the natural mangrove vegetation that grew profusely on the river banks and apparently slowed down lateral water movement from rivers and river effluents.

About one million hectares of arable land have been salinized by this latter process, resulting in massive abandonment of precious agricultural land.

Salinization results in the creation of so-called "tannes" (highly degraded salty land literally tanned or "burnt up"). Strong westerly winds blow the salt particles from the tannes towards the cultivated land resulting in further expansion of the salinized areas.

There were attempts to stop saltwater movement by creation of small dams on the effluents of the big rivers. Even though this technology works, it is not practiced on a large scale due to the high investment required for building and maintaining these dams.

A new technology for reclamation of saline soils

A technology for reclamation of saline soils was developed and tested by a research team comprising scientists from Institut Sénégalais de Recherche Agricole (ISRA), the University of Dakar and ICRISAT. The program was financed by the International Development Research Centre (IDRC).

A trial aimed at testing the technology was carried out in the Saloum River delta by the village of

Rice growing in de-salinized basins in Kaolack.

N'Diafate located 25 km south of the town of Kaolack. The trial was conducted between 2001-2004 on a 10-hectare plot.

The soils surrounding the riverbeds are of a fine texture with a low rate of water infiltration. Furthermore, a gelatinous layer excreted from blue green algae produces a "biological crust" that further hinders water infiltration that could cover the soil surface. Mean annual rainfall is around 700 mm. This amount of water could leach much of the salts from the upper soil layer if not for the fact that most rainwater is not absorbed by the soil.

The first step was to erect tall earth ridges, 50 cm high and 40 cm wide. These ridges circled an area of 750-1000 m^2 creating basins that retained rainwater. Rainwater infiltrated into the soil and leached the surface salt.

The basins were planted with an exotic tree called *Tamarix aphylla* var. erectus. This is an erect salt and water logging tolerant, fast growing tree. It has an important economic value since it produces a very hard timber suitable for tool handles and quality furniture. The *Tamarix* trees evacuate the soil moisture through transpiration thus allowing better infiltration of rainwater.

As predicted, the creation of the basins resulted in significant leaching of salts. The proportion of the ground in the basins covered by plants grew from 23% in the first year to 65% in the third experimental year. In this year the dry weight of the biomass of natural vegetation produced in the basins was 2,700 kg/ha as compared with 900 kg/ha in the untreated control.

Tamarix trees grew at an average rate of 0.7 m/year to reach more than 2.5 meters in height after three years.

The basins arrested salt movement in the soil allowing the production of millet above the experimental field.

It seems that the creation of a belt of basins above the riverbeds can produce an effective barrier for salt movement away from the river. Planting of *Tamarix* trees in the basins results in improved water infiltration. The trees also catch the salt particles blown by the wind from the tannes towards cultivated fields.

We are now seeking funds to test the above technology coupled with agroforestry systems comprised of salt tolerant fruit trees and annual crops.

A good stand of Tamarix *(if not for the weeds) in Kaolack.*

A Story of Six Villages

To improve the livelihoods of poor farmers in the semi-arid tropics we have to study their lifestyles before making knowledgeable decisions about development pathways. ICRISAT did this through a program called Village Level Studies (VLS).

A poor family sharing their meager meal in an Andhra Pradesh village.

We carried out Village Level Studies during 1975-84 in six villages of India – Aurepalle and Dokur in Mahabubnagar district of Andhra Pradesh, Shirapur and Kalman in Solapur district, and Kanzara and Kinkheda in Akola district of Maharashtra. We revived the studies in 2002 and have analyzed the data collected during 2001-04. The study brought out that joint families, which were dominant during 1975-84, gave way to more nucleated families, bringing down the average family size from 8.37 to 5.38. Literacy levels improved substantially, and the inequality seen between the older generations of different size groups has vanished in case of younger people.

In 1975-78, most households in the sample depended on farming as their major occupation. This changed in 2001-04. Smaller families, better literacy and more diversified occupations have placed these households in a position to attain a rapid development on many pathways. Compared to 1975-78, households in 2001-04 had less land to operate. Irrigation made a big difference. Maharashtra villages improved their position due to better access to surface irrigation, while the Andhra Pradesh villages became much worse-off due to setbacks in irrigation.

The cropping patterns in the VLS villages have undergone drastic changes in the last three decades. The importance of cash crops has increased, although productivity levels varied between regions and crops. While the yield levels in 2001-04 were better than those obtained in 1975-78, they were still low when compared to the yields recorded under irrigation. Drought remained the most dominant constraint for crop production. Pests, diseases, weeds and excess rains also constrained the performance of crops. Progressive farmers, relatives and friends are still the most important sources of information on agronomic practices. Most of the crop produces were sold in markets. The integration of markets and reduction in the transaction costs had enabled them to have a greater market orientation than the subsistence orientation, which was the dominant motive three decades ago.

Due to steadily increasing costs of production and stagnant product prices, crop production has become non-remunerative even when the productivity levels increased. Farmers made profits in less than one-third of their plots and did not recover even variable costs in more than one-third of the plots. The livestock sector has a stabilizing effect on the incomes of these farmers, but the economics of livestock enterprises in these villages do not support this belief.

As the incomes declined from agricultural enterprises, sample households relied more on non-farm activities to generate incomes. Some non-farm labor income increased only by a small proportion and hasn't emerged as a major source of income. Other non-farm activities such as salaried jobs, rental incomes, interest on savings or money-lending and self-employment options emerged as the chief providers of income, accounting for slightly more than 50 per cent of the total net incomes. The average annual household incomes increased by 103 per cent between 1975-78 and 2001-04. The increase was even sharper at 120 per cent in terms of the per capita income. The relative position of the six villages has undergone a major change with Solapur villages surging forward and Akola and Mahabubnagar villages remaining stagnant. The gap between the labor households and landholding households narrowed down and poverty levels were much lower in the labor households when compared to land owning households.

The large variability noted across villages in household incomes was not visible in consumption expenditures. The surpluses and shortfalls noted in the incomes were moderated by savings and borrowings. The average consumption expenditure of Rs 26,665 accounted for about 81 percent of the average household income of Rs 32,818. Overall, 47 percent of the households suffered energy inadequacy while 53 percent experienced protein malnutrition.

Women from Andhra Pradesh participated more in the village labor market than those from Maharashtra. Women in general and those from labor households participated more in agricultural work, while men, particularly from land owning groups, participated more in non-agricultural work. The average earnings of women participants was one-third to one-half of the male earnings. On an average, the real wages of male labor increased by 138 percent between 1975-78 and 2001-04.

Very little investments were made on soil conservation. Most of the investments were for strengthening field bunds and leveling of fields. Farmers invested substantially on water exploration, with more emphasis on bore wells in Andhra Pradesh and on open dug wells in Maharashtra. The average command area per functional water source in VLS villages was 1.8 hectares, and the returns to investments on irrigation were around 10 percent per year.

Coping mechanisms during droughts include borrowing, drawing from old savings, finding work in non-farm activities and migration. Government programs contributed about eight per cent of the annual average household incomes, but while the programs intensified over time, the targeting has worsened.

The six villages have certainly developed despite certain setbacks. With more diversified livelihood options available now and with improved access to education and wide-ranging skills, these villagers are poised for even a faster economic growth in the near future.

Focus group meeting with the villagers in a Maharashtra village.

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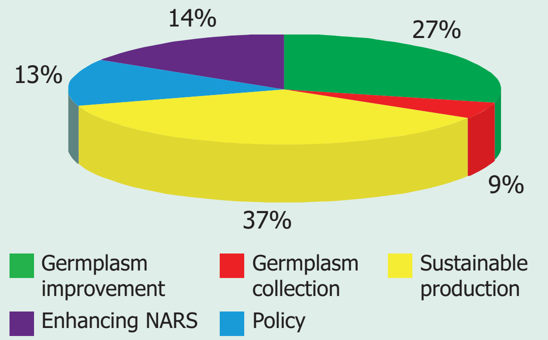
Financial Summary

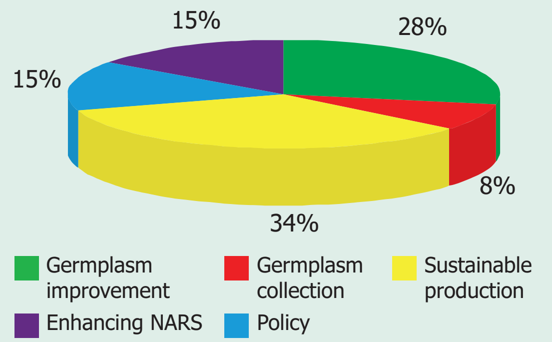
Balance sheet

	2006	2005
	US$ thousands	
Assets		
Cash and cash equivalents	22,086	9,240
Investments	10,227	17,994
Accounts receivable	4,803	6,830
Inventories	566	549
Prepaid expenses	303	291
Property and equipment - net	5,075	5,123
Other assets	1,005	881
Total Assets	44,065	40,908
Liabilities		
Accounts payable	6,070	5,428
Accruals and provisions	478	405
Payments in advance from donors	8,304	7,615
Long-term liabilities	11,300	10,801
Total Liabilities	26,152	24,249
Net Assets		
Unrestricted		
Unappropriated	5,723	4,476
Appropriated	9,822	9,989
Permanently restricted	2,368	2,194
Total Net Assets	17,913	16,659
Total Liabilities and Net Assets	44,065	40,908

Expenditure by CGIAR Activity – 2006



Expenditure by CGIAR Activity – 2005



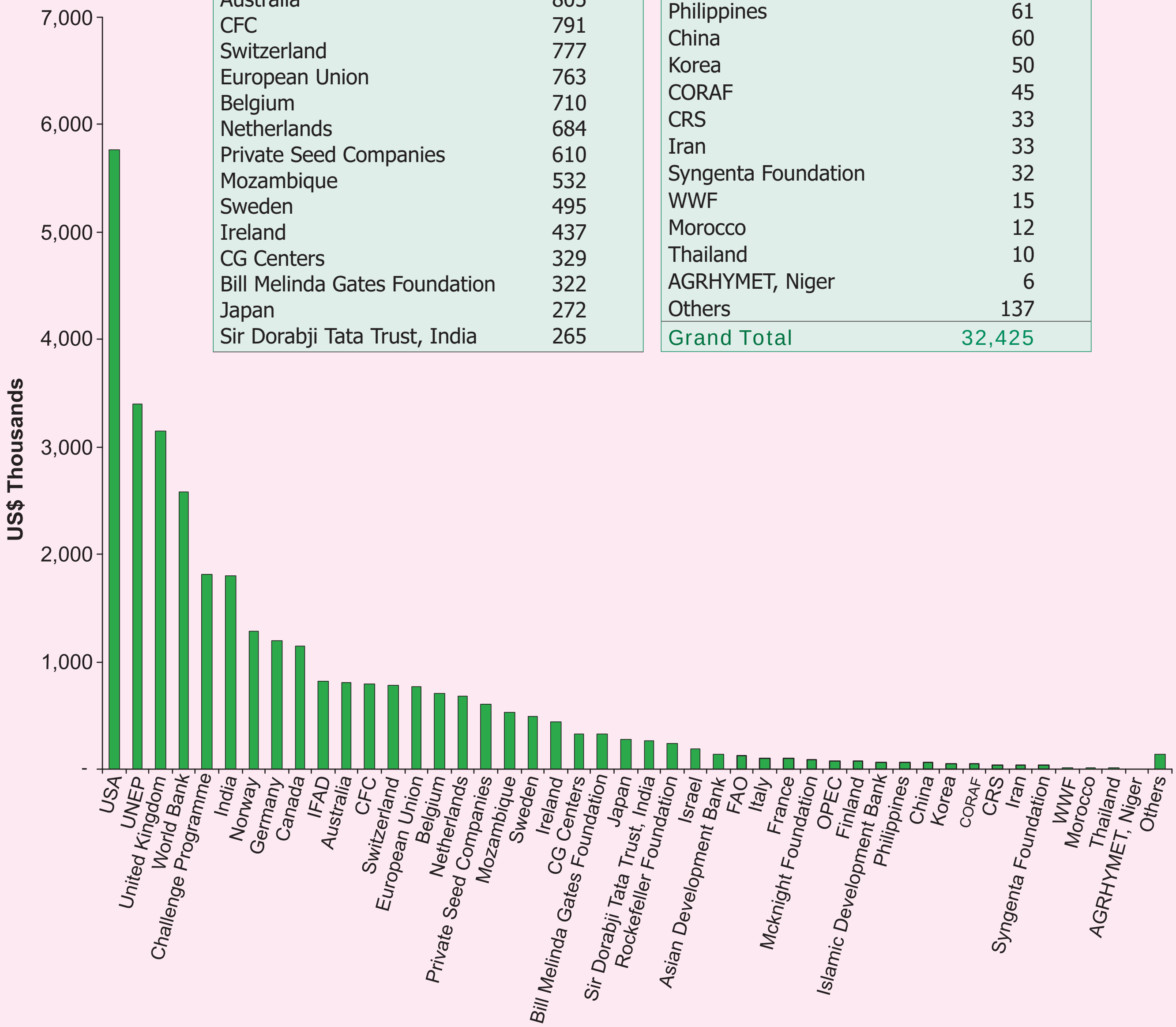
Operating results and movements in net assets

	2006	2005
	US$ thousands	
Operating results		
Revenue	35,345	29,779
Expenditure	34,098	28,750
Change in net assets, operational	1,247	1,029
Net assets - Unrestricted		
Unappropriated		
Balance, beginning of the year	4,476	3,447
Operating (deficit)/surplus for the year	1,247	1,029
Balance, end of the year	5,723	4,476
Appropriated		
Balance, beginning of the year	9,989	10,133
Acquisition of physical facilities	(167)	(144)
Balance, end of the year	9,822	9,989
Total net assets - Unrestricted	15,545	14,465
Net assets - Permanently restricted	2,368	2,194
Total net assets	17,913	16,659

Grant income from donors for 2006

Donor	US$ '000
USA	5,769
UNEP	3,398
United Kingdom	3,147
World Bank	2,578
Challenge Programme	1,817
India	1,799
Norway	1,285
Germany	1,194
Canada	1,142
IFAD	824
Australia	805
CFC	791
Switzerland	777
European Union	763
Belgium	710
Netherlands	684
Private Seed Companies	610
Mozambique	532
Sweden	495
Ireland	437
CG Centers	329
Bill Melinda Gates Foundation	322
Japan	272
Sir Dorabji Tata Trust, India	265

Donor	US$ '000
Rockefeller Foundation	244
Israel	185
Asian Development Bank	138
FAO	125
Italy	97
France	96
Mcknight Foundation	90
OPEC	72
Finland	71
Islamic Development Bank	68
Philippines	61
China	60
Korea	50
CORAF	45
CRS	33
Iran	33
Syngenta Foundation	32
WWF	15
Morocco	12
Thailand	10
AGRHYMET, Niger	6
Others	137
Grand Total	32,425



ICRISAT in


RURAL ECONOMY
THE FINANCIAL EXPRESS
Icrisat cautions India against impact of climate change
Says such change may hurt people living below the poverty line
"It would be a crime if we view the situation in business as usual manner. The poor can be made less vulnerable with greater science and knowledge-based interventions and significant donor support from for research and implementation"
Icrisat develops cure for bollworm attack
MAKING ETHAN
Icrisat, Rusni Distilleries develop mo
THE HINDU • THURSDAY, SEPTEMBER 13, 2007
ICRISAT chief to chair UN panel
The Economic Times
Groundnut bowl is full no longer
New Indian Express 3 Hyderabad
Friday, September 21, 2007
Hard times ahead for farm sector, says Icrisat chief
and the Pea
India Daily
ఈనాడు
మెదక్
సమష్టి
OUTLOOK india.com
A Village's Watershed M
Article
CGIAR

the News

SeedQuest News section
odel for using sweet sorghum
Icrisat, ICAR hold research meet
Al Gore Of Science. Being About William Dar & 'Science With A Human Face'
Frank A. Hilario
June 24, 2007
In the developing world, agriculture is the most promising site of growth – since the Green Revolution, it has always been full of promises, promises, promises.
మెదక్
THE HINDU
Opinion
Dryland farmers and climate change

ICRISAT rated "Outstanding" based on CGIAR Performance Indicators, 2006

Indicator	ICRISAT's Performance
Outputs and output targets	96 percent achieved
Outcomes assessment	6.00 on a scale of 1-10
Center commitment to document impacts	7.30 on a scale of 1-10
Overall impact assessment performance	8.55 on a scale of 1-10
Peer-reviewed publications per scientist	2.43 per scientist
Publications with developed country partners	49 percent
Financial health indicators:	
Short-term solvency (liquidity)	171 in a range of 90-120 days
Long-term financial stability	114 in a range of 75-90 days
Efficiency of operations (indirect cost ratio)	23
Cash management on restricted operations	0.27
Does the Board have a clear strategy for communicating with stakeholders (including CGIAR members, other Centers, Partners)?	Yes
Does the Board have an approved schedule for CCERs on program matters	Yes
Did the Board discuss and act on any significant deviations (more than 10 percent) from the budget	No, there were none
IRS nationality concentration	India 31 percent, Kenya 8 percent
Are procurement policies and their implementation fully consistent with the CGIAR guidelines	Yes, fully enforced
Does your Center have Board-approved gender diversity goals?	Yes
Scientists receiving PhDs in last 5 years	9 percent

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(Name, Designation, *Nationality*, (Location))

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T Kulashekar, Senior Manager, Internal Audit, *India*

Prabhat Kumar, Director, Business and Country Relations, *India* (New Delhi)

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Mark D Winslow, Marketing Specialist, *USA*

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AJ Rama Rao, Senior Manager, Human Resources Services, *India*

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K Jagannadham, Senior Manager, Transport, *India*

Security Office

TD Peter, Head, Security Services, *India*

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Deputy Director General's Office

JDH Keatinge, Deputy Director General-Research, *Ireland*

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JVDK Kumar Rao, Special Project Scientist, *India*

S Marimuthu, Scientist (Agronomy), *India*

Rosana P Mula, Special Project Scientist (Post Doctoral), *Philippines*

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Piara Singh, Principal Scientist (Soil Science), *India*

TK Sreedevi, Scientist-Watershed Development, *India*

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Global Theme – Biotechnology (GT-Biotech)

David Hoisington, Global Theme Leader-Biotechnology, *USA*

Vanamala Anjaiah, Special Project Scientist, *India*

Jayashree Balaji, Scientist-Bioinformatics, *India*

Pooja Bhatnagar, Scientist (Cell/ Molecular Biology), *India*

Subhash Chandra, Principal Scientist (Statistics) & Head-Bioinformatics, *India*

CT Hash, Principal Scientist (Breeding), *USA*

Junichi Kashiwagi, Associate Scientist, *Japan*

Nalini Mallikarjuna, Senior Scientist (Cell Biology), *India*

L Krishna Murthy, Scientist (Plant Physiology), *India*

T Nepolean, Special Project Scientist, *India*

S Senthilvel, Special Project Scientist, *India*

Kiran K Sharma, Principal Scientist (Cell Biology), *India*

Vincent Vadez, Senior Scientist (Plant Physiology), *France*

Rajeev K Varshney, Senior Scientist (Applied Genomics Laboratory), *India*

Global Theme - Crop Improvement (GT-CI)

CLL Gowda, Global Theme Leader-Crop Improvement, *India*

Ashok Alur, Project Coordinator-CFC Project, *India*

Ranjana Bhattacharjee, Scientist (Pearl Millet Breeding), *India*

PM Gaur, Principal Scientist (Breeding), India

SN Nigam, Principal Scientist (Breeding), *India*

Suresh Pande, Principal Scientist (Pathology), *India*

KN Rai, Principal Scientist (Breeding), *India*

GV Ranga Rao, Special Project Scientist, IPM, *India*

Belum VS Reddy, Principal Scientist (Breeding), *India*

Aruna Rupakula, Scientist (Breeding), *India*

OP Rupela, Principal Scientist (Microbiology), *India,*

KB Saxena, Principal Scientist (Breeding), *India*

HC Sharma, Principal Scientist (Entomology), *India*

Rajan Sharma, Scientist (Cereals Pathology), *India*

Rakesh Srivastava, Scientist (Pigeonpea Breeding), *India*

RP Thakur, Principal Scientist (Pathology) and Head, Plant Quarantine Unit, *India*

HD Upadhyaya, Principal Scientist (Genetic Resources), *India*

Farid Waliyar, Principal Scientist (Pathology) and Special Assistant to DG Agri-Science Park, *France*

Global Theme - Institutions, Markets, Policy and Impacts (GT-IMPI)

MCS Bantilan, Global Theme Leader-Institutions, Markets, Policy and Impacts, *Philippines*

P Parthasarathy Rao, Senior Scientist (Economics), *India*

K Purnachandra Rao, Principal Scientist (Village Level Studies), *India*

Agri-Business Incubator (ABI)

MS Karuppan Chetty, Manager, ABI, *India*

S Aravazhi, Asst. Manager, Agri-Business Incubator, *India*

Agri-Science Park (ASP)

Abdul Rahman Ilyas, Chief Operating Officer, ASP, *India*

Farm Engineering Services (FES)

M Prabhakar Reddy, Head, Farm Services, *India*

KRC Bose, Manager, Engineering Services, *India*

Knowledge Management Sharing (KMS)

V Balaji, Head, KMS, *India*

Pradyut Modi, Manager, Information Systems Unit, *India*

S Srinivas, Head, Library and Documentation Services, *India*

West and Central Africa (WCA)

Niamey, Niger

Saidou Koala, Director, WCA *Burkina Faso*

Ramadjita Tabo, Asst Regional Director and Principal Scientist (Agronomy) *Chad*

MS Diolombi, Regional Administrator, *Nigeria*

Bruno Gerard, Senior Scientist, GT-AE, *Belgium*

Bettina Haussmann, Senior Scientist (Pearl Millet Breeding), *Germany*

Jupiter Ndjeunga, Senior Scientist-Economics, GT-IMPI, *Cameroon*

Albert Nikiema, Post Doctoral Fellow, *Burkina Faso*

Dov Pasternak, Principal Scientist-Desert Margin Issues, GT-AE, *Israel*

O Smith, Principal Scientist, *Canada* (Niamey)

Lennart Woltering, Associate Professional Officer (Water Management Specialist), *Netherlands*

Bamako, Mali

BR Ntare, Principal Scientist (Breeding) and Country Representative, *Uganda*

Dieye Mbene Faye, Special Project Scientist (Socioeconomics), GT-CI, *Senegal*

Margret Loeffen, Associate Professional Officer (Socioeconomics) *Netherlands*

Tom van Mourik, Associate Professional Officer (Agronomy-*Striga*) *Netherlands*

Eva W Rattunde, Principal Scientist (Sorghum Breeding & Genetic Resources), GT-CI, *Germany*

HFW Rattunde, Principal Scientist (Sorghum Breeding & Genetic Resources), GT-CI, *USA*

Marjolein Smit, Associate Professional Officer (Human Nutrition), GT-CI *Netherlands*

PCS Traore, Manager, GIS, GT-AE, *Mali*

Eastern and Southern Africa (ESA)

Nairobi, Kenya

SN Silim, Director, ESA, *Uganda*

RB Jones, Assistant Regional Director, ESA, *UK*

Peter Cooper, Principal Scientist, GT-AE, *UK*

Dan Kiambi, Project Coordinator-Sorghum *Striga,* GT-Biotech, *Kenya*

Bancy Embura Mati, Regional Facilitator-IMAWESA, *Kenya*

Mary WK Mburu, Project Manager-Lucrative Legumes Project, *Kenya*

Mary A Mgonja, Principal Scientist (Breeding), GT-CI, *Tanzania*

Barnabas Mitaru, Regional Network Coordinator – ECARSAM, *Kenya*

Githiri S Mwangi, Regional Scientist, *Kenya*

Philip Ndungu, Regional Administrator, *Kenya*

KPC Rao, Special Project Scientist, GT-AE, *India*

Bekele Shiferaw, Senior Scientist-Resource and Development Economics, GT-IMPI, *Ethiopia*

Santie M de Villiers, Regional Scientist (Legume Cell Biology), GT-Biotech *South Africa*

Kassa Semagn, Molecular Geneticist/ Technical Coordinator, *Ethiopia* (Nairobi)

Bulawayo, Zimbabwe

David D Rohrbach, Principal Scientist (Economics) & Country Representative *USA*. Separated January 2007.

Steven J Twomlow, Global Theme Leader, GT-Agroecosystems, *UK*

Paul Belder, Associate Professional Officer (Dryland Agrohydrology) *Netherlands*

John P Dimes, Senior Scientist (Farming Systems Modeling), GT-AE, *Australia*

Sabine Homann, Post Doctoral Fellow, *Germany*

Lewis Hove, Post Doctoral Fellow , *Zimbabwe*

Kizito Mazvimavi, Post Doctoral Fellow, *Zimbabwe*

Isaac J Minde, Senior Scientist (Economics), GT-IMPI, *Tanzania*

Andre F van Rooyen, Coordinator (Desert Margins), GT-AE, *South Africa*

Swathi Sridharan Editor-ESA, *India*

Lilongwe, Malawi

Moses Siambi, Country Representative and Senior Scientist-Agronomy, *Kenya*

Jane Alumira, Scientist-Impact Assessment, GT-IMPI, *Kenya*

ES Monyo, Principal Scientist (Breeding), GT-CI, *Tanzania*

Moses Osiru, Associate Professional Officer (Groundnut Pathology), GT-CI, *Uganda*

Janneke Verheije, Associate Professional Officer (Sociology), GT-IMPI, *Netherlands*

Maputo, Mozambique

Carlos E Dominguez Otero, Country Representative and Seed Systems Specialist, *Colombia*

Collaborative Staff

AVRDC

Madan L Chadha, Director AVRDC-RCSA, *India* (Patancheru)

CIP

Sarathchandra G Ilangantileke, Post Harvest Specialist, *Sri Lanka* (New Delhi)

CIMMYT

Ashish Srivastava, Senior Scientist, *India.* Separated June 2007

CIRAD

Benoit Clerget, Principal Scientist-Echo-Physiology, *France* (Bamako)

Fabrice Sagnard, Principal Scientist - Population Genetics, *France* (Bamako)

ILRI

Augustine Ayantunde, Team Leader, *Nigeria* (Niamey)

Peter G Bezkorowajnyj, Project Manager, *Canada,* (Patancheru)

Michael Blümmel, Project Team Leader, South Asia, *Germany* (Patancheru)

Oumar Diall, Veterinary Scientist, *Mali,* (Bamako)

Anjani Kumar, Senior Scientist (Agricultural Economics) (New Delhi), *India*

IPGRI

PN Mathur, Principal Scientist, *India* (New Delhi)

IWMI

Madar Samad, Theme Leader, *Sri Lanka* (Patancheru)

JIRCAS

Ryoichi Matsunaga, Team Leader and Soil Scientist, *Japan* (Niamey)

Keiichi Hayashi, Soils Scientist, *Japan* (Niamey)

Akira Kamidohzono, Soil Scientist, *Japan* (Niamey)

ODI

Catherine Longley, Special Project Scientist-ODA, *UK* (Nairobi)

ROCARS

Aboubacar Toure, Associate Coordinator, *Mali* (Bamako)

Suri Sehgal Foundation

MD Gupta, Technical Director, *India* (Patancheru)

WWF

Biksham Gujja, Special Project Scientist, *India* (Patancheru)

Development Investor Partnerships Initiated in 2006

Supplementing the CGIAR's core support to carry out new targeted projects

Donor	Project	Collaborators
ASARECA	Integrated Striga Management for Improved Sorghum Productivity in ECA	
ASARECA/IFAD	Improved Management of Agricultural Water in Eastern and Southern Africa (IMAWESA)	
Australia	Improvement of Salinity and Boron Toxicity Tolerance in Chickpea	Centre for Legumes in Mediterranean Agriculture (CLIMA), University of Western Australia, Australia
	Regional Workshop on "Minimizing Aflatoxin Risk in Peanuts"	Queensland Department of Primary Industries and Fisheries, Australia; Indian Council of Agricultural Research, India; Osmania University, India; Idonesian Legumes and Tuber Crops Research Institute (ILETRI), Indonesia; Center for Tropical Biology (BIOTROP), Indonesia
Canada	An Aflatoxin Risk Early Warning System to Improve Nutrition, Health and Income in West African Smallholders Farms	Université de Sherbrooke (UdS), Canada; Institut d'Economie Rurale, Mali; Savanna Agricultural Research Institute (SARI), Ghana; Agrhymet Regional Center, Niger;
	Roundtable on Technology Resources in Support of the Agricultural Education/ Extension Grid	Commonwealth of Learning (COL), Canada
EU, thru KVL, Denmark	Sahelian Fruit Trees (SAFRUIT) Project	Royal Veterinary and Agricultural University, Denmark; University of Copenhagen, Denmark
FAO, Zimbabwe	Assess the Impacts of Seed Fairs in Zimbabwe	NGOs in Zimbabwe
	Improving the Contribution of Micro-Irrigation to Rural Livelihoods in Zimbabwe	University of Zimbabwe, Zimbabwe; International Water Management Institute, South Africa
Germany	Introduction of Rural Production Systems for Jatropha and Other Oil-bearing Plants for Biofuel Production in Local Level - Country-India	Southern Online Biotechnologies Ltd, India; Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Germany
	Mobilizing Regional Diversity for Creating New Potentials for Pearl Millet and Sorghum Farmers in West and Central Africa	Lake Chad Research Institute (LCRI), Nigeria; Institut National de Recherches Agronomiques du Niger (INRAN), Niger; Institut National de l'Environnement et Recherche Agricole (INERA), Burkina Faso; Institut d'Economie Rurale (IER), Mali; Institut Sénégalais de Recherche Agricole (ISRA), Senegal; Universität Hohenheim (UH), Stuttgart, Germany
Global Crop Diversity Trust	Development of a Strategy for the Global Conservation of Pigeonpea Genetic Resources	Bioversity International, Italy

Donor	Project	Collaborators
	Development of a Strategy for the Global Conservation of Sorghum Genetic Resources	Bioversity International, Italy
IFAD	Growing out of Poverty: Intensification of Sorghum and Millet Systems by Unlocking the Potential of Local Biodiversity and Market opportunities in Semi-Arid West Africa	Institut d'Economie Rural (IER), Mali; Institut de l'Environnement et des Recherches Agricoles (INERA), Burkina Faso; Institut National de Recherche Agronomique du Niger (INRAN), Niger; Lake Chad Research Institute, Nigeria; Institute for Agricultural Research, Nigeria; Association des Organisations des Paysans Professionels (AOPP), Mali; Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), France
India	Training Course for Officers and Lead Farmers on PE activities	Rural Development, Government of Andhra Pradesh, India
	Comprehensive Assessment of Watershed Programmes in India	Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, India
	Mid-Term Evaluation (MTE) of selected 16 NWDPRA Watersheds in the Southern Zone of India	Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, India
	Development of Elite Planting Material and Model Plantation	National Oilseeds and Vegetable Oils Development Board (NOVOD), India
	Centre of Excellence for high-throughput allele determination for molecular breeding	Department of Biotechnology, Government of India; India
	Evaluation of function and allele mining for candidate drought responsive genes in pearl millet (*Pennisetum glaucum* L.)	Department of Biotechnology, Government of India; India
	Construction of the transcript map and development of functional molecular markers for chickpea	National Center for Plant Genome Research, India
	Evaluation, Validation and Introgression of transgenic Chickpea and Pigeonpea for Resistance to the Legume Pod borer, *Helicoverpa armigera*	Indian Council of Agricultural Research, India
	Losses due to Stem Borer Damage in Rabi Sorghum and the Role of Bio-Control Agents in Reducing the need for Pesticide Application	National Research Center for Sorghum (NRCS), India
	Marker-Assisted Breeding for Pearl Millet Downy Mildew Resistance and Terminal Drought Tolerance	All India Coordinated Pearl Millet Improvement Project, Indian Council of Agricultural Research, India
	Evaluating candidate genes towards enhancement of drought tolerance in chickpea (*Cicer arietinum*)	National Research Center on Plant Biotechnology, India; Indian Agricultural Research Institute, India; Sri Vallabh Pant University of Agriculture and Technology, India

Donor	Project	Collaborators
	Pigeonpea Genomics Initiative under US Agricultural Knowledge Initiative (AKI)	National Research Center on Plant Biotechnology, India; Indian Institute of Pulses Research, India; University of Agricultural Sciences, Dharwad, India; Panjabrao Deshmukh Krishi Vidaypeeth University, India; Banaras Hindu University, India
	Pearl millet marker-assisted research	Indian Council of Agricultural Research, India
	Gene-based Genetic Maps and Molecular Markers for Abiotic Stress Tolerance in Cultivated Groundnut	National Research Center for Groundnut, India; University of Agricultural Sciences, Dharwad, India
	An Innovative Approach for Rehabilitation of Marginal Lands of Uttaranchal by Introducing an Eco-Friendly Legume Based Technology	Department of Agriculture, Government of Uttaranchal, India
	Preparation of NRGES Perspective Plan for Chamoli District, Uttaranchal	Department of Agriculture, Government of Uttaranchal, India
	Assessment of Mycotoxin Contamination in Sorghum and its By-products in Andhra Pradesh	National Research Center for Sorghum (NRCS), India
	Development of Extra-large Seeded Kabuli Chickpea Varieties for Crop Diversification	Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, India
	Application of Micro-organisms in Agriculture and Allied Sectors	National Bureau of Agriculturally Important Microorganisms, India
	Development and Popularization of 'Model' Seed System(s) for Quality Seed Production of Major Legumes to Ensure Seed-Sufficiency at the Village Level	National Research Centre for Groundnut, India; Indian Institute of Pulses Research, India and other NARS Partners
Islamic Development Bank	The Dates for the Sahel Project: Supporting Sahelian Countries in Combating Poverty through Date Palm Cultivation and Youth Employment (Training at ICRISAT Sadore)	Member countries of Islamic Development Bank
Mozambique	Support for Interaction Between Farmers, and Agricultural Concession Companies through Accelerated Technology Exchange	Instituto de Investigacao Agraria de Mocambique (IIAM), Mozambique
Netherlands	Exploitation of Wild Relatives of Pigeonpea for Resistance to Pod Borer, *Helicoverpa armigera*	Acharya NG Ranga Agricultural University, India; NGOs in Andhra Pradesh, India
	Associate Experts Programme - Dr. Moses Omongin Osiru; Ms. Marjholein Smit	Netherlands Minister for Development Cooperation
Others		
WWF	Evaluation of Components of Yeild Formation in SRI and Conventional Methods of Rice Cultivation 2006	
American Jewish World Service (AJWS), USA	Techno-Agriculture Innovation for Poverty Alleviation (TIPA) in Senegal	World Vision, Senegal; Green Senegal, Senegal

Donor	Project	Collaborators
BASF, Germany	Testing of a Fungicide with Potential Drought Alleviation Effects on Different Crops	
Coco Cola Foundation	Improved rural Livelihoods through Increased Rainwater Conservation and Use Effiency	Department of Agriculture, Government of Tamil Nadu, India
Catholic Relief Services	Funding, Implementing and Monitoring the Seeds System and Security Assessment component and Farmer Field Schools of the Project in Support of Vulnerable Households in the Districts of Douentza	
McKnight Foundation	Sustainable Seed Supply: Farmer Managed Seed Marketing Initiatives for Sorghum and Pearl Millet in Mali, Burkina Faso and Niger.	
	Farmer Participatory Improvement of Sorghum and Pearl Millet Genetic Resources for Increased Adaptation to Diverse Production Environments in West Africa (06-014)	
	ALIVE and Nutritious Cropping Systems: A Participatory Approach to Legume Intensification and Variety Enhancement	
	An Be Djigui: Use of Local Diversity for Enhancing Nutrition in Sorghum/Pearl Millet Consuming Communities.	
	Developing Short and Medium-Duration Groundnut Varieties with Improved Yield Performance, Acceptable market Traits and Resistance to Foiar Diseases	
Proagro Seed Company Pvt. Ltd	Fortification of Downy Mildew Resistance of a Proagro Millet Restorer Parent PP29.	
Rudraram Research Institute for Agricultural Sciences (RRIAS)	Evaluation of Various Fertilizer Products in Glasshouse conditions	
SM Sehgal Foundation	ICRISAT/SMSF Joint Collaborative Project - Exploiting Gene Synteny to Improve Stem Borer Resistance Mapping in Sorghum	
Solar Electric Light Fund (SELF), USA	Benin Micro-Irrigation Project-Phase 1	
Syngenta Foundation for Sustainable Agriculture	Enhancement of the Set of Microsatellite (SSR) Markers for Improving Pearl Millet Breeding Efficiency in Africa and Asia	
	Harnessing Modern Science in Africa to Sustain Sorghum and Pearl Millet for Resource-Poor Farmers.	
UK	Risks, Shocks, Growth and Poverty: Evidence from Long-term Household Panel Data	Oxford University, UK

Donor	Project	Collaborators
UNEP/GEF	Combating Desertification in South Asia: the Agriculture-Environment Nexus	International Center for Agricultural Research in the Dry Areas, Syria; International Food Policy Research Insitute (IFPRI), USA; National Center for Agricultural Economics and Policy (NCAP), India; Central Research Institute for Dryland Agriculture (CRIDA), India; Soil & Water Conservation Research Institute, Pakistan; Pakistan Institute of Development Economics, Pakistan
USA	Agricultural input markets strengthening	International Fertilizer Development Center, USA; NARS in Mozambique
	Rural Livelihood Diversified-Agriculture Policy Harmonization - Seed Systems Development	NARS in sub-Saharan Africa
	Rural Livelihood Diversified-Agriculture Policy Harmonization - Chinyanja Legumes Network	NARS in sub-Saharan Africa
	A program for capitalizing on Agricultural Technology Advances in the West Africa Sorghum Research Network (WCASRN/ ROCAS)	NARS in West and Central Africa
	Support for International Virology and Legume Genomics Workshop Conferences	
World Bank	Implementation of the First Phase of the Follow-up Survey of Farming Households in the Districts of Mahabubnagar and Ananthapur	
	Assessing Impacts of Land Rehabilitation Programs on Poverty and Sustanable Land Management in Niger	
	Community Action Program (CAP): Plantation of *Acaia senegal* for carbon sequestration, income generation and land rehabilitation	
	Implement the Second Phase of the follow-up Survey of Farming Households in the Districts of Mahabubnagar and Ananthapur	
	Risk, social networks, interventions and poverty: Investigating poverty and wealth dynamics in India	
Consortia of donors (via CGIAR)		
IFAR	Identification and Field-Testing of Salinity Tolerant Groundnut in Saline Areas of India - Fellowship Grant to Ms Namita Srivastava	Central Rice Research Institute, India; International Rice Research Institute, Philippines

Donor	Project	Collaborators
IFPRI	Transaction Costs, Imperfect Market and Agricultural Commercialization in Less Favoured Areas: The Role and Rural Institutions and Farmer Organizations for Improving Markets in Semi-Arid Kenya	Michigan State University, USA; International Food Policy Research Institute, USA; University of Nairobi, Egerton University, Catholic Relief Service, and Technoserve, Kenya
ILRI	Developing the Framework for the Ex-Ante Impact Assessment of Food-Feed Resource Options to Promote Sustainable Livelihoods of resource Poor Smallholders	International Livestock Research Institute, Kenya
CIMMYT: Generation Challenge Program	Cultivating Plant Diversity for the Resource Poor – Generation Challenge Program Commissioned Research Activities - A dataset on allele diversity at orthologous candidate genes in GCP crops (ADOC) - Genotyping composite collection of Finger Millet - Development of a composite collection and the genotyping of Foxtail millet - Development of a composite collection and the genotyping of pearl millet - Development of a composite collection and the genotyping of pigeonpea - Evaluation and deployment of transgenic drought tolerant varieties - Management of Generation CP Central Registry - Development of Ortholog-Function Display Tools - Development of an integrated decision support system for MAS and MAB - Development of an integrated GCP information platform - Creation of institutional bioinformatics capacity - Installation and implementation of the ICRISAT LIMS at the Biosciences Eastern and Central Africa (BecA) facility and IITA-Ibadan - Reporting for Product Distribution: An Asset Inventory System for the GCP - Integration of the High Performance Computing (HPC)-facilities in the Generation CP toolbox: 2005-27. Generation CP Data Quality Improvement and Assurance	IRRI, CIAT, EMBRAPA, ICARDA, Agropolis, CIP, INRA-CNG, CIMMYT, JIRCAS, University of Tsukuba, WUR, IPGRI, University of California, CIRAD, NIAS, African Centre for Gene Technologies, ILRI, IITA
Attributed support for core programs from Japan, France, India, Iran, Italy, and World Bank is not listed but is included in Financial Summary.		

Research Scholars During 2006

Names	Country	Degree	Topic
Completed during 2006			
Vanam Sunitha	India	MSc	Population dynamics and management of *Maruca vitrata* on short duration pigeonpea
V Raja Ram	India	MSc	Development of TRAP markers for genes in carotenoid biosynthesis pathway in sorghum and pearl millet
Tsunashima Hiroyuki	Japan	PhD	Low input agriculture for sustainable development and ecosystem maintenance
M Rupasree	India	PhD	Salt stress tolerance in pearl millet and development of molecular markers
M Swathi Sree	India	PhD	Analysis of biochemical and physiological response of legumes to drought
R Prathibha	India	PhD	Molecular mapping of Ascochyta blight resistance in chickpea
S Nedumaran	India	PhD	Assessing the impacts of policy and technological interventions in micro-watersheds. A bio-economic modeling approach
K Sireesha	India	PhD	Determination of efficacy of different HaNPV strains and standardization of production procedures
Bhushan Rameshrao Kavimandan	India	PhD	Molecular markers for identification of sorghum varieties and hybrids
Continuing during 2006			
Ch Siva Kumar	India	PhD	Biochemical mechanisms of resistance to sorghum shoot fly *Atherigona soccata*
G Velu	India	PhD	Genetic variability, stability and inheritance of grain iron and zinc content in pearl millet [*Pennisetum glaucum* (L.) R.Br.]
Shivaji Pandurang Mehtre	India	PhD	Genetic diversity analysis QTL mapping and marker-assisted selection for shoot fly resistance in sorghum
Vijay Abarao Dalvi	India	PhD	Study genetics cytology and stability of cytoplasmic genetic male sterility system in pigeonpea
V Thirumala Rao	India	PhD	Breeding approaches to exploit heterosis for grain mold resistance in sorghum
G Kalyani	India	PhD	Transgenic groundnut with resistance to foliar diseases
K Baskaran	India	PhD	Use of SSR markers in characterizing responses to population improvement during breeding of released pearl millet variety
A Ramakrishna Babu	India	PhD	Evaluation of transgenic chickpea for resistance to pod borer *Helicoverpa armigera* Hubner

Names	Country	Degree	Topic
D Srinivasa Reddy	India	PhD	Gene expression in groundnut transgenics under abiotic stress conditions
G Sreelatha	India	PhD	Genetic transformation for pod borer resistance through Agrobacterium in pigeonpea [*Cajanus cajan* (L.)]
T Jyothi	India	PhD	SSR-marker assisted backcross introgression of QTL's for host plant resistance to shoot fly in sorghum
M Jyostna Devi	India	PhD	Identification of mechanisms for drought response in groundnut (*Arachis hypogaea* L.)
G Dileep Kumar	India	PhD	Reusable Learning Objects (RLO) for rapid content generation and localization: A new paradigm for agricultural education
Kassahun Bantte Bisetegn	Ethiopia	PhD	Drought tolerance in sorghum
Srinivasa Reddy Srigiri	India	PhD	Equity and poverty issues in watershed development projects in India
Madhurima Bhatnagar	India	PhD	Development and characterization of transgenic groundnut plants for enhanced production of β-carotene to combat vitamin A malnutrition
Namita Srivastava	India	PhD	Molecular and physiological characterization of genetic variation for salinity tolerance in the core germplasm of pigeonpea and groundnut
B Valentine Joseph Gandhi	India	PhD	Migration and HIV Aids
P Ramu	India	PhD	Development and application of EST-SSR marker in sorghum
Fatema S Husain	India	PhD	Introgression of fungal disease resistance from wild Arachis
V Vengadessan	India	PhD	Genetics of panicle and seed size in pearl millet
T Padmaja	India	PhD	Evaluation of Bt toxins and its metabolites against Helicoverpa
Sowmini Sunkara	India	MTech	Development of transgenics for resistance to *Aspergillus flavus* in the Lipoxiginase genes
P Naga Padmini	India	MTech	Tissue culture and transformation of chickpea for insect resistance
T Mahender	India	PhD	Genetic and genomic mapping of pearl millet using EST and other markers for abiotic stress tolerance
V Surekha Devi	India	PhD	PhD thesis on interaction of acid exudates in chickpea on the biological activity of CRY toxins from *Bacillus thuringinensis* against *Helicoverpa armigera*
Ch Sridhar Kumar	India	PhD	Influence of abiotic factors on infection and response of immune systems of Helicoverpa to bio-pesticides Metarhizium and NPV

Names	Country	Degree	Topic
Joined during 2006			
Mr Venot Jean Philippe	France	PhD	Agrarian change and access to water in the lower Krishna basin
Mr Guilaume Laberge	Denmark	PhD	Tracers in root studies
Ms Suzuki Kanako	Japan	Phd	Soil crop growth
Mr Evans Mutegi	Kenya	PhD	Environmental risk assessment of genetically modified sorghum
Mr Ch V Subba Reddy	India	PhD	Molecular characterization of SCSMV
Mr Andreas Gramzow	Germany	PhD	Policy measures to improve rural livelihoods in India
Ms Christina Nyhus Dhillon	USA	PhD	The effects of major crop commodities on iron intake in rural India (1972-2002)
Ms Martin P Morano	Italy	PhD	Provision of public goods through participatory planning: on experimental exploration of the deliberative process
Ms Jana Kholova	Czech Re-public	PhD	Comparative study of tolerance of sorghum under salinity (drought) stress
Ms A Bharathi	India	PhD	Phenotypic and genotypic diversity in the finger millet germplasm
Mr J Shridhar Rao	India	PhD	Influence of abiotic factors on infection and response of immune systems of *Helicoverpa* to bio-pesticides (Metarhizium and NPV)
Eva van den Broek	Netherlands	MSc	Sorghum production by Malian women – its role/importance
Lelatou Younoussi Hassane	Niamey	BAP/DAP	Secrétariat Bilingue
Amadou Boubacar	Niamey	Bachelor	Caractérisation des accessions de Mil de l'Afrique de l'Ouest pour les carectères Morphologiques et Phénologiques et pour la Résistance au Striga
Guira Basga	Niamey	Bachelor	Estimation de la vigueur hybride et de l'aptitude à la combinaison des accessions de Mil [*Pennisetum glaucum* (L.) R. Br.] de l'Afrique de l'ouest
Maiga Saadatou Boubé	Niamey	BTS	Comptabilité Gestion
Kassari Ango Issoufou	Niamey	Bachelor	Evaluation participative des préférences paysannes pour les variétés de Mil (Sud Ouest Niger : Cas de Sadoré et Léléhi)
Rahamatou Oumarou	Niamey	Bachelor	Secrétariat Bilingue
Stella Njoki Wambugu	Kenya	MSc	Analysis of the impact of social capital on smallholder farmers' income, market access, and farmer group performance in Kenya
Tarcisius Kiambi Mutuoki	Kenya	MSc	Analysis of factors affecting commercialization of groundnut production in Kenya
Julius Kirimi Sindi	Kenya	PhD	Essays on Market Access: Linking Farmers to Market Through Collective Action

Workshops, Conferences, Meetings during 2006

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
The Annual Pulse Network Meeting of the Indo-Swiss Collaboration in Biotechnology (ISCB), 2-4 Feb	ICRISAT, Patancheru	28		Dept. of Biotechnology, Govt. of India, and Swiss Agency for Development and Cooperation (SDC)
The International Symposium on Management of Vector-Borne Viruses and the 16th Annual Convention of the Indian Virological Society (IVS), 7-10 Feb	ICRISAT, Patancheru	200		ICRISAT, Indian Virological Society
Roundtable Discussion on Setting Up Online Grids of Educational and Extension Materials, and for Capacity Strengthening, 15 Feb	ICRISAT, Patancheru	28	Canada, India, Philippines	ICRISAT, COL
Workshop on Corporate and Science & Technology Institutions Partnership for Inclusive and Sustainable Development and Economic Growth, 27 Feb	ICRISAT, Patancheru		India	CII-ICRISAT
Indo-US international legume workshop on application of genomics tools to chickpea, pigeonpea and groundnut crop improvement, 6-9 Mar	ICRISAT, Patancheru	35	India, USA	Indo-US forum, Univ. of California, ICRISAT
National workshop on Emerging issues and development strategies for dryland agriculture and wasteland management, 6-8 Mar	CRIDA, Hyderabad		India	CRIDA, ICRISAT
A planning workshop on CFC-FAO-ICRISAT project on Enhanced utilization of sorghum and pearl millet grains in poultry feed industry to improve livelihoods of small scale farmers in Asia, 11-12 Apr	ICRISAT, Patancheru	25	India	CFC-FAO-ICRISAT
A regional sorghum and pearl millet breeder's meeting, 25-28 Apr	Bamako, Mali	18		ICRISAT
Project Completion Meeting of the *Program for farmer participatory improvement of grain legumes in rainfed Asia,* 8-10 May.	ICRISAT, Patancheru	68	India, China, Nepal and Vietnam	IFAD
First workshop to plan the development of foundation seed enterprises in Francophone countries of sub-Saharan Africa, 8-12 May	Bamako, Mali	30	Nine Francophone African Countries	ICRISAT, SCOSA, AFSTA
Workshop to plan the forthcoming project entitled *Support for interaction*	ICRISAT, Nairobi	15		ICRISAT

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
between farmers and agricultural concession companies through accelerated technology exchange 15-16 May				
Workshop on *Comprehensive Assessment of Watershed Programs in India,* 6-7 Jun	NAAS, New Delhi	70	India	ICRISAT, Ministry of Rural Development and Ministry of Agriculture, Govt. of India
Workshop on *Agribusiness: Forward Linkages and Backward Integration,* 9 Jun	ICRISAT Patancheru	40	India	ICRISAT
Media Dialogue on the International Year of Deserts and Desertification (IYDD), 23 Jun	New Delhi	40	India	CGIAR
Consultation workshop for the National Agricultural Innovation Project (NAIP) on Enabling sustainable rural livelihoods through enhanced farming system productivity in rainfed areas, 22 Jun	CRIDA, Hyderabad	23	India	ICRISAT, CRIDA
Roundtable Consultation on Technology Resources in Support of the Agricultural Education/Extension Grid, 29 Jun	ICRISAT, Patancheru	22	India	ICRISAT, COL
First meeting of the core group on watershed impacts, 11-12 Jul	ICRISAT, Patancheru	20	India	ICRISAT
Tata-ICRISAT-ICAR Project Review and Planning Meeting, 19-20 Jul	ICRISAT, Patancheru		India	ICRISAT-TATA-ICAR
Workshop on harmonizing biosafety rules in the Asia-Pacific region, 31 Jul-2 Aug	ICRISAT, Patancheru	30	India, Sri Lanka, Bangladesh, China, Indonesia, Iran, Malaysia, the Philippines, Nepal, Papua New Guinea, Thailand and Vietnam.	ICRISAT, APCoAB

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
National workshop on Rejuvenating tanks for sustainable livelihoods – Emerging trends, 3-4 Aug	ICRISAT, Patancheru			ICRISAT, WWF, ISEC, MARI
Media workshop on reporting agri-biotechnology for journalists from Andhra Pradesh reporting in Telugu and English, 7-8 Aug	ICRISAT, Patancheru	25	India	ICRISAT, ISAAA
National workshop to review the research accomplishments, and to identify opportunities to strengthen the ties with the national Department of Agricultural Research and Extension (AREX), and related public and private research and extension programs, 26 Jul	Harare, Zimbabwe			ICRISAT, ICRAF, CIAT/TSBF, CIFOR and CIMMYT – CGIAR research institutes in Zimbabwe
Consultation meeting on Developing a strategy for the global conservation of pigeonpea genetic resources, 23-24 Aug	ICRISAT, Patancheru	24	India, Tanzania	ICRISAT, Global Crop Diversity Trust
The Second Pan Africa seed trade harmonization meeting, 14-16 Aug	ICRISAT, Nairobi	13	SADC, COMESA, FAO, WASNET, CILSS, WAEMU, AU, STAK, ECAPAPA, SSC-ISU	ICRISAT, SCOSA, AFSTA
Second workshop to plan the development of foundation seed enterprises in Francophone countries of sub-Saharan Africa, 11-14 Sep	Dakar, Senegal	30	Nine Francophone African Countries	ICRISAT, SCOSA, AFSTA
Symposium/workshop on `From Desert to Oasis', 23-25 Sep	Niamey, Niger	100		ICRISAT and ICARDA
Reusable Learning Objects Workshop, 6-7 Oct	ICRISAT, Patancheru	13	India, UK, USA,	ICRISAT, Imperial College London
Workshop for the development of a web-based seed catalogue to support regional variety release in East and Central, Southern and West Africa	Nairobi, Kenya	11	SADC, FAO, ILRI, CILSS, KEPHIS	ICRISAT, SCOSA, AFSTA

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
First workshop to plan the development of foundation seed enterprises in Anglophone and Lusophone countries of sub-Saharan Africa, 25-29 Sep	Nairobi, Kenya	36	11 Anglophone and two Lusophone African Countries	ICRISAT, SCOSA, AFSTA
Second workshop to plan the development of foundation seed enterprises in Francophone countries of sub-Saharan Africa, 31 Oct-3 Nov	Nairobi, Kenya	36	11 Anglophone and two Lusophone African Countries	ICRISAT, SCOSA, AFSTA
First AGRIS Workshop on Open Access in Agricultural Sciences and Technology: Indian Initiatives, Nov 6-7	ICRISAT, Patancheru	22	India, Italy, Germany	FAO, ICRISAT
Consultation Workshop on Design and Development of Curriculum and Syllabus for MS Program in Agro-ecology, 23-23 Nov	ICRISAT, Patancheru	10	India	ICRISAT
Biannual Regional Stakeholders Workshop, 20-22 Nov	Dar es Salaam Tanzania	45	Tanzania	ECARSAM
The First International Conference on Indigenous Vegetables and Legumes from 12-15 Dec	ICRISAT, Patancheru	220	42 Countries	AVRDC and ISHS
Workshop on Capacity building for Biotechnology and bio-based products in ECA, Dec	Rwanda	15	Rwanda	The McGill University, Montreal, Canada and Kegall Institute of Science and Technology, Rwanda

Training Courses held during 2006

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
Training of PAC technicians on tree propagation and nursery management techniques 16-20 Jan	ICRISAT Niamey	19	Niger	Finland, Mashav
Training Workshop on Applications of coarse to high resolution satellite imagery for land productivity assessment and Management, 6-17 Feb	ICRISAT, Bamako, Mali	36	Representatives from 12 Countries	USGS Eros Data Center, The Agrhymet Regional Center, Regional Center for mapping of Recourses for Development, SADC's Regional Remote Sensing unit and FAO's Global Land cover Network
Training program on bulk storage, grading and marketing of sorghum and pearl millet, 27-28 Feb	Maharashtra	40	Farmers from 3 clusters of Maharashtra	ICRISAT
Training of trainers on date palm and vegetable production techniques, 27-31 Mar	ICRISAT Niamey	18	Burkina Faso, Chad, Mali, Mauritania, Niger, Senegal	Islamic Development Bank (IDB)
Training on the technology of Sahelian Ecofarm (SEF), 3-5 Apr	ICRISAT Niamey	22	Chad, Mali, Niger, Senegal	World Vision
Training Program on Scaling-out the Benefits of Productivity Enhancement Initiatives of Integrated Watershed Development, 24 Apr-3 May	ICRISAT Patancheru	64	India	ICRISAT
International Training Course on Pearl Millet Improvement and Seed Production, 2-15 May	ICRISAT Patancheru	43	Botswana, Dubai, India, Kenya, Myanmar, Niger, Oman, Pakistan, Palestine, Sudan, Syria, Tanzania, Uzbekistan, USA, Zambia, Zimbabwe	FAO, INTSORMIL, ICBA, SYGENTA

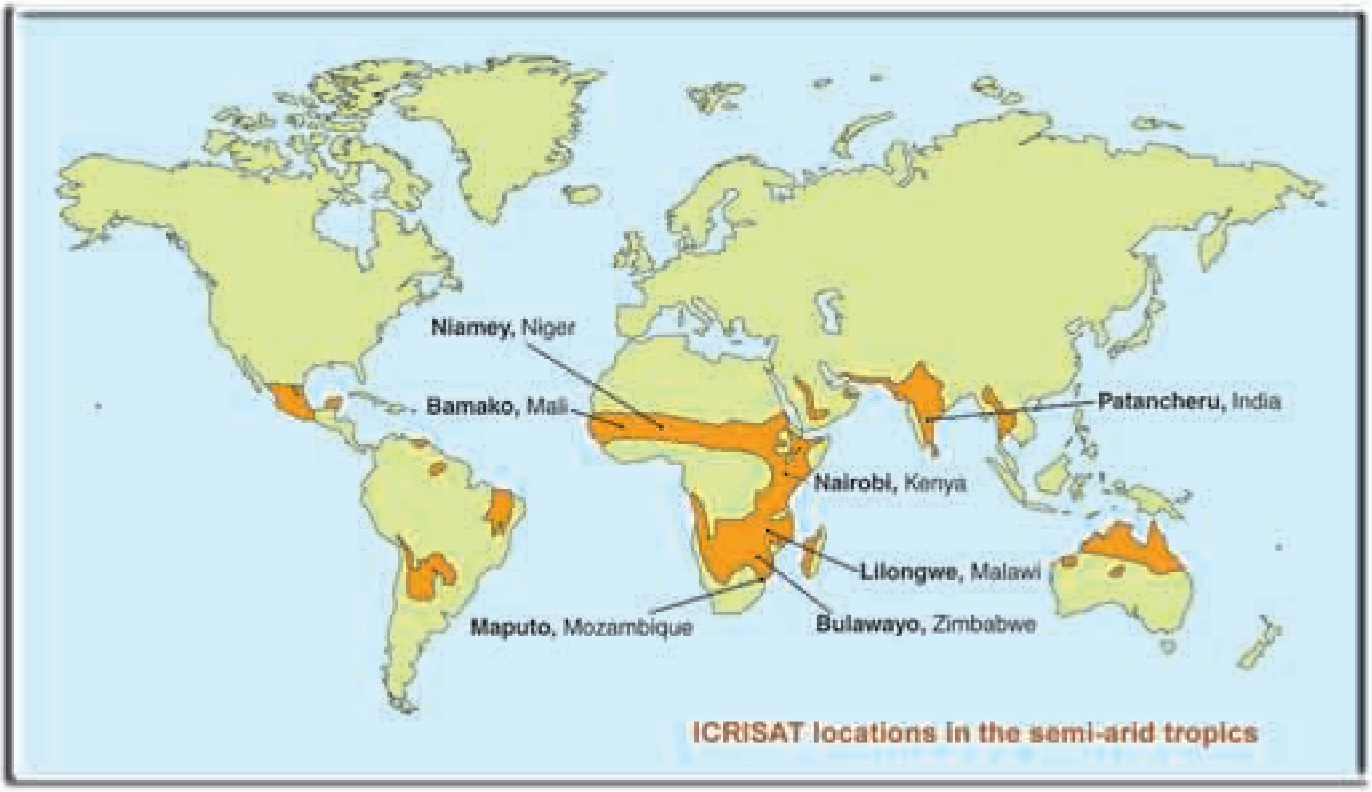
Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
Training on Fruit tree propagation	ISC Sadoré	17	6 Countries	ISC and UNCCD
GIS training course 31 Jul-4 Aug	ICRISAT Patancheru	18	India, Sri Lanka, Mali	University of Florida
Learning Workshop on Biological Approaches for Crop Production and Protection, 7-12 Aug	ICRISAT Patancheru	17	India	ICRISAT
Training on HNPV production and utilization for Agricultural Officers and Farmers, 25-27 Sep	ICRISAT, Patancheru	27	India	ICRISAT
Learning Workshop on Biological Approaches for Crop Production and Protection, 3-7 Oct	ICRISAT, Patancheru	25	India	ICRISAT
Training on HNPV production and utilization for Agricultural Officers and Farmers, 16-18 Oct	ICRISAT, Patancheru	26	India	ICRISAT
Training Program on Water Management, 23-24 Oct	ICRISAT, Patancheru	18	Angola, Canada, India, Kenya	ICRISAT
Training program on Integrated Watershed Management for improving rural livelihoods, 23-24 Oct	ICRISAT Patancheru	20	India, Angola, Kenya and Canada	ICRISAT Patancheru
Training on HNPV production and utilization for Agricultural Officers and Farmers, 30 Oct-01 Nov	ICRISAT, Patancheru	26	India	ICRISAT
Training program for farmers, 6-16 Nov	ICRISAT Patancheru	79	Farmers from 22 Districts of AP	ICRISAT Patancheru
Learning program on Crop Improvement, Genetic Resource and Seed Systems with Focus on Legumes, 7-24 Nov	ICRISAT, Patancheru	13	Uzbekistan	ICRISAT, Govt. of Uzbekistan

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
Training of Trainers for Productivity Enhancement in integrated Watershed Management, 6-16 Nov	ICRISAT, Patancheru	79	India	ICRISAT
Training course on date palm in-vitro plants acclimatization and nursery techniques for fruit trees, December	Sadoré	17	Burkina Faso, Mali, Mauritania, Niger, Senegal and Chad	ICRISAT Sahelian Center and UNCCD
Vegetables seed multiplication and storage course 4-8 Dec	ICRISAT Niamey	27	Niger, Benin	Finland, Mashav
Nursery management and tree propagation techniques, 11-15 Dec	ICRISAT Niamey	28	Benin, Burkina Faso, Ghana, Mali, Niger	Finland, Mashav
Initiation to date palm tissue cultured plants acclimatization and tree nursery techniques 18-22 Dec	ICRISAT Niamey	17	Burkina Faso, Chad, Mali, Mauritania, Niger, Senegal	Islamic Development Bank (IDB)

Publications

(List available on CD version. Distribution on request.)


The New ICRISAT
2004-05
• Fourth King Baudouin Award
• Rated Superior by CGIAR
• US $ 30 M budget
• High staff morale
• Budget surplus
2006-07
• New vision and strategy to 2015
• Two CGIAR Science Awards
• Fourth year of budget surplus
• High staff morale
• Rated Outstanding by CGIAR
• US $ 35 M budget (2007)
2002-03
• Team ICRISAT
• Third King Baudouin Award
• External reviews
- Quality science
- Sound management
• Institutional innovations
• Budget surplus (2003)
Mid 90s:
• Financial and human resource challenges
• Declining support
2000-01
• Institutional transformation through Science with a Human Face
• Grey to Green Revolution
• US $ 22 M budget
ICRISAT
International Crops Research Institute for the Semi-Arid Tropics



About ICRISAT®

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a nonprofit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 600 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

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