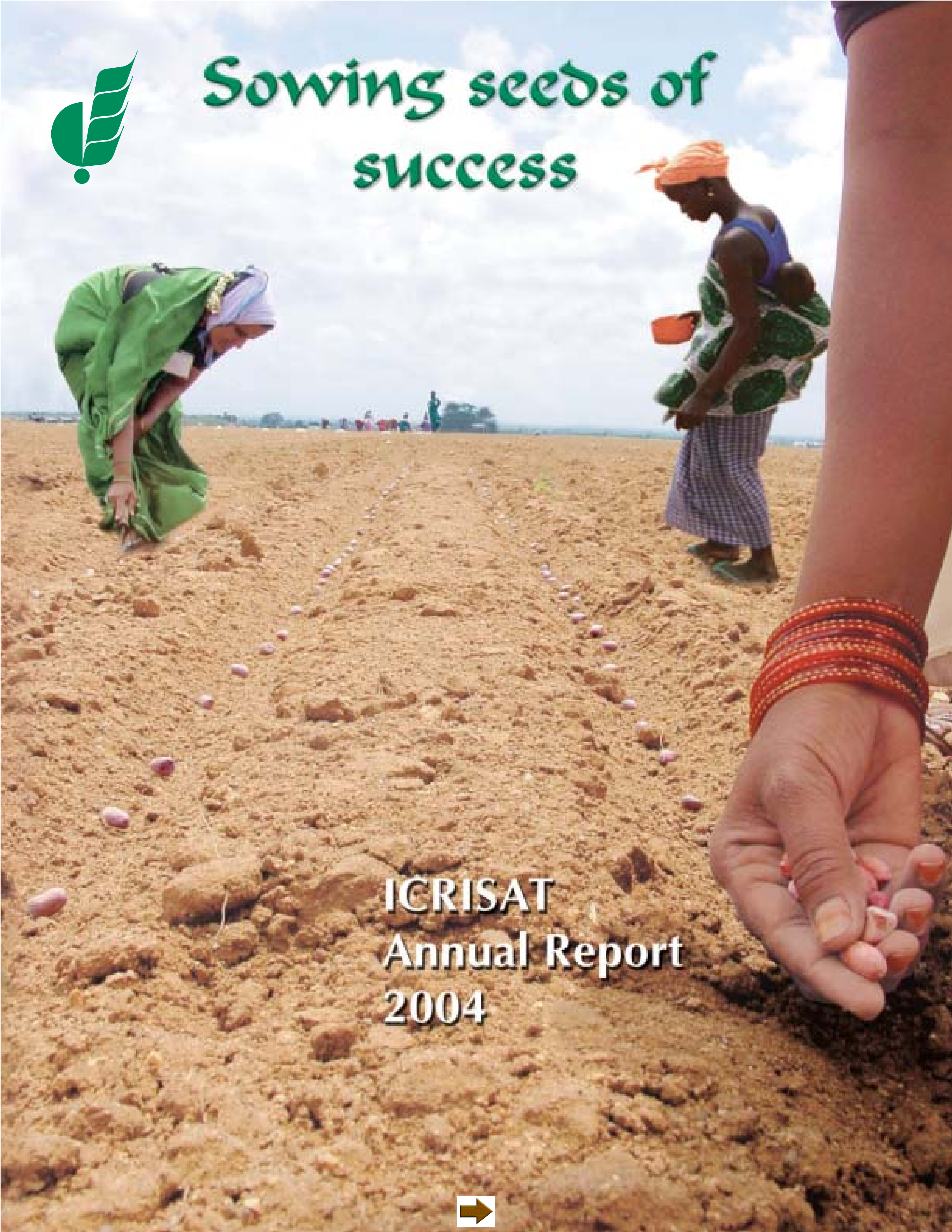
Sowing seeds of success



ICRISAT Annual Report 2004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AND RURAL DEVELOPMEN
FOR Dr.S.P.WANI NATI


PLAZA HOTEL SANTIAGO CITY
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Contents

Message from the Chairman and the Director General

It is a novelty and a pleasure to be writing a joint message for ICRISAT's Annual Report this year, reflecting in no small measure the strong and extremely productive bond between Team ICRISAT and its Governing Board – entities that complement each other so well, that it is difficult to find a definite dividing line.

The time between the last Annual Report and this one has been profusely encouraging. The Institute has leap-frogged into prominence due to its unique achievements, and has bravely and proudly declared a turnaround for the better.

You will have seen the following in other documents, but the Governing Board and management recently strengthened it, and it is worth mentioning ICRISAT's noble guideposts – our vision, mission and mandate.

Vision – The improved well-being of the poor of the semi-arid tropics through agricultural research for impact.

This has given us the determination to substantially contribute to the attainment by our primary clientele, of the Millennium Development Goals (MDGs), specifically those that tackle poverty, hunger, gender and health issues.

Mission – To help the poor of the SAT through science with a human face and partnership-based research for development to increase agricultural productivity and food security, reduce poverty, and protect the environment in SAT production systems.

Mandate – To improve the livelihoods of the poor in semi-arid crop-livestock-tree production systems through integrated genetic and natural resource management strategies. ICRISAT will make major food crops more productive, reliable, nutritious, and affordable to the poor; diversify utilization options for staple food crops; develop tools and techniques to manage risk and utilize the natural resource base of SAT production systems in a more sustained fashion; develop options to diversify income generation; and strengthen delivery systems to key clients. Partnership-based research for impact, gender sensitivity, capacity building and enhanced knowledge and technology flows are integral to this mandate.

In keeping with challenges in the SAT areas of the developing world, ICRISAT focuses on research through **four global research themes**, namely:

1. *Markets, Policies and Impacts* to inform and provide strategic direction and prioritization of research issues. It also responds to market chain analyses including seed policy issues and on more effective impact generation. The poor face a wide range of social and economic constraints, so we maintain constant communication with them to understand their needs and seek solutions.

2. *Harnessing Biotechnology for the Poor* to augment and enhance gains from plant breeding by applying biotechnology, and by developing accurate and cost-effective tools to diagnose pathogens and toxins.

3. *Crop Improvement, Management and Utilization for Food Security and Health* to improve and sustain crop productivity, farm income, food security and protect the environment of the semi-arid tropics. We develop improved and diversified cultivars, eco-friendly and cost-effective pest management practices, and aim to commercialize alternative uses of our crops including utilization and commercialization of new cultivars.

4. *Agroecosystems* aims to improve rural livelihoods and increase food security through sustainable integrated natural resource management. Water is always in short supply in the dry tropics, so we place special importance on watershed management (including water harvesting techniques in the SAT of sub-Saharan Africa) and increasing farmers' incomes through more intensive cropping including introduction of livestock into the production system.

The theme of this report is "Sowing Seeds of Success". We have included some of our success stories – each one demonstrating how ICRISAT is contributing to improved livelihoods in the semi-arid tropics of Africa and Asia. We are grateful to our partners and development investors for the trust they place in our efforts and for the superb support extended to us. In addition to the reports documented here we must record other encouraging aspects of our research and endeavors towards our mission.

ICRISAT is continuing to make big strides in the field of biotechnology. Not only did ICRISAT win the prize in February this year for the best stall to exhibit its results at the BioAsia 2004 convention, but more importantly, the results of our work in genetic transformation is producing very promising results – to wit, the world's first transgenic groundnut against the dreaded peanut clump virus (currently in the third year of contained field trial), and the world's first transgenic pigeonpea, with resistance to pod borer (in the second year of field trial). ICRISAT has also succeeded in developing a sorghum cultivar resistant to stem borer.

The technologies we developed in watershed management are increasingly sought after as they are adapted in more and more locations in the dry areas of Asia. In Africa our natural resource management scientists have contributed by skillful crop diversification – introducing new crops and techniques to old lands, which ironically exploit the goodness of the land while enriching it at the same time. The agroecosystems team is also forging ahead with promotion of plantations that will produce bio-diesel, aromatic and medicinal plants.

The sugar content of sweet sorghum developed by our scientists is up to 23% and is a good source of ethanol that can be blended with petrol and diesel. ICRISAT's sweet sorghum has caught the attention of leaders in the state of Andhra Pradesh and other states of India. They have requested ICRISAT to help promote this crop throughout the state on a large scale.

Our efforts with the Virtual Academy of the Semi-Arid Tropics (VASAT), have progressed to a new level. Many more partners have joined the coalition, and learning modules that help rural communities to cope with drought and other issues, have been loaded into the system.

Although we can look back on our accomplishments with great satisfaction, knowing fully well that these couldn't have been achieved without hard work and dedication to our duties, we have to remember to keep going, to keep running, to continue in our noble purpose, to strive towards the vision we have set for ourselves – only then can we hope to reap a bountiful harvest of success from the seeds we have sown.

Uzo Mokwunye
Chairman, Governing Board

William D Dar
Director General

Rebuilding the pyramids

Everybody knows that groundnuts (or peanuts, as they are known in many countries) provide a tasty snack. But few people in the developed world are aware that groundnuts are also an essential part of the diets of millions of poor people. In West Africa, groundnut, which is rich in protein, oil, amino acids and vitamins, is both an important food and a cash crop.

The groundnut pyramids of Kano, which disappeared due to rosette in the 1980s, have risen again.

Nowhere is groundnut more important than in Senegal, where groundnut occupies 40% of all cultivated land, and where half the country's population is engaged in one way or another in its production. Senegal remains the only country in West Africa that largely depends on the external groundnut market. The crop is also hugely important in Nigeria, which produces a third of Africa's total and 6% of global production. Nigeria and Senegal are the largest groundnut producers in Africa, and rank amongst the top five in the world. Traditionally, in both countries, groundnuts are piled into enormous pyramids while awaiting export to foreign markets.

The bad news

But serious problems have plagued both countries. In Senegal, the land area sown to groundnut decreased by 20% during the 1980s. In Nigeria, production plummeted during the same period. The main reason for the decline was a nasty virus disease called groundnut rosette. Rosette, which is endemic to Africa, retards plant growth and prevents pods from maturing. The disease wreaks havoc throughout sub-Saharan Africa. In Nigeria alone, more than 700,000 hectares of groundnut worth US$250 million were destroyed by rosette in the pandemic year of 1975. Things got worse before they got better – additional epidemics affected the region in 1983, 1985 and 1988. These persistent onslaughts forced millions of farmers to switch to cereal crops and cowpea. For farming families whose lives had depended on groundnut production for generations, the situation was so bleak that they simply gave up trying, and the great groundnut pyramids of Kano and Dakar disappeared.

Of all plant diseases, viruses are the most difficult to control because few chemical substances are available for eradicating them from the plants they attack. Chemicals are available for controlling their vectors – the mites and insects that carry them – but these are unreliable, unavailable and unhealthy. Cultural practices can reduce disease incidence, but cannot eliminate them. The most effective control measure is the use of resistant cultivars.

This is where ICRISAT, the world's premier center for groundnut improvement, came into the picture. The introduction of elite lines of groundnut developed in collaboration

with partners from the national research programs of various African countries, notably Nigeria, Senegal and Malawi, have worked wonders for groundnut farmers.

The good news

The success of these collaborators has been spectacular. Since 1986, groundnut has made an astonishing comeback. From a pitiful total of only 0.7 million tons in 1986, for example, Nigeria's groundnut production totaled nearly 3 million tons in 1997 (Figure 1).

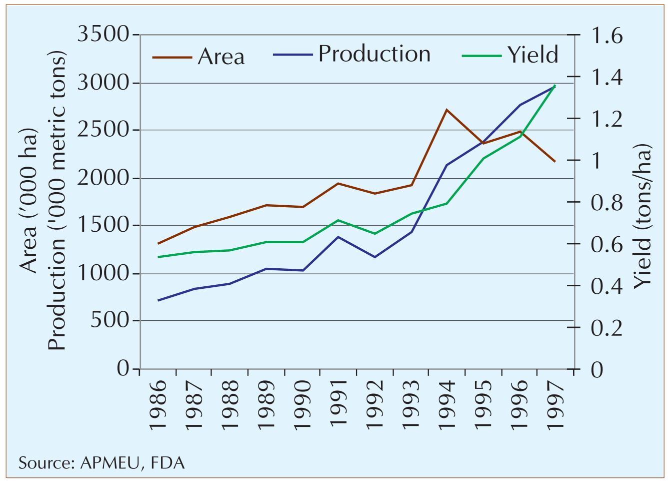


Figure 1. Groundnut production in Nigeria, 1986-97.

The virus that causes groundnut rosette has been given more attention than other disease because of its unusual virulence. Although rosette has been around for a long time, it was little understood until recently. First observed in 1907, the causal organisms were only reported half a century later in 1966. It was not until 1990 that resistance to initial infection was reported by Dr PE Olorunju, a plant breeder with Nigeria's Institute for Agricultural Research (IAR), and a long-time ICRISAT partner.

Once the disease had been identified, the research focus was on selecting breeding materials for disease resistance. But when it became clear that all available resistant varieties were long-duration, the focus was widened to incorporate early maturity into the breeding material. This research was a resounding success. Armed with new resistant products, farmers were able to sow groundnut once again.

The use of resistant varieties has also had a positive impact on the environment because the use of resistant lines, together with timely planting and right spacing, reduces the use of insecticide sprays.

Back to business

Small-scale industries, which were forced to close by rosette, have revived. According to Dr Olorunju, West African oil mills that lay idle for nearly a decade are now making profits from both edible oil and groundnut cake, which is used for poultry feeds.

The new products brought about through the energetic partnership between ICRISAT and West African national research programs has resulted in increased production and reduced losses to disease. Most importantly, it has dramatically improved the morale of farmers, who have been empowered to once again cultivate their favorite crop.

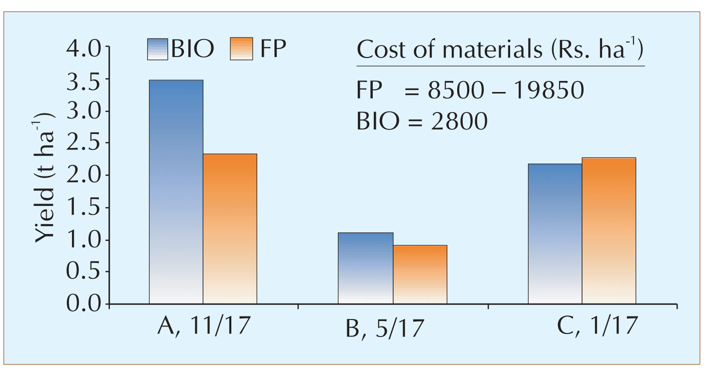
Transporting the produce.

Protecting crops, eco-friendly way

Money spent on chemical pesticides for protecting some crops from insect-pests and diseases can generally be about 50% of the total input costs of raising the crop. Cotton is one such crop. Cotton-boll-worm (*Helicoverpa armigera*) is the major insect-pest of cotton. The same insect is also called legume pod-borer and bores into the pods of several other crops, including pigeonpea, and eventually into the lives of poor farmers in the semi-arid tropics. Over the years, this insect has developed resistance to several different chemical pesticides.

Farmers examine a cotton field.

Published scientific literature and documented (both formal and informal) knowledge of farmers suggested that it should be possible to protect crops by using low-cost eco-friendly alternatives. Based on the research done and understanding of the insect, we developed a protocol for protecting crops from insect-pests. This protocol was evaluated at ICRISAT-Patancheru for four years on different crops, including pigeonpea and cotton. In addition to using items traditionally known to farmers, it involved wash of composts prepared from foliage and twigs of two herbs, Neem (*Azadirachta indica*) and *Gliricidia sepium* (a leguminous tree) using a method modified at ICRISAT. The two microorganisms involved were, a bacterium (*Bacillus megaterium* strain BCB19) and a fungus (*Metarrhizium anisopliae*). Multiplication of the two microorganisms on a large scale is being fine-tuned so as to attract private sector manufacturers of biopesticides. Liberal doses of fertilizer nitrogen are known to encourage proliferation of insect-pests and are therefore avoided. Instead, compost application was encouraged. A bacterial strain CDB35 (*Pseudomonas fluorescent*) which promotes plant growth and solubilizes insoluble-P was applied to the soil at sowing time. Trap crops, which attract insect-pests and result in reduced damage to the main crop, was an important feature.



Cotton yield of farmers representing three groups – A) those who harvested at least 30% more, B) at par, and C) marginally lower than the relevant control plots.

Encouraged by the success at ICRISAT-Patancheru in managing *Helicoverpa* in an on-going long-term experiment initiated in 1999, it was decided in 2003/04, to evaluate the protocol on-farm, in the village Kothapally in a farmer participatory mode. The farmers wanted to evaluate the protocol on cotton. The Acharya NG Ranga Agricultural University (ANGRAU), Hyderabad, partnered us in this evaluation. Seventeen farmers agreed to take up the experiment on a 4000 m^2 area divided into two equal parts. One

part used chemical pesticides, called Farmers' Practice (FP) and the other used the low-cost materials, indicated above and provided by us (we called it Biopesticides – BIO). Biopesticides were applied as a prophylactic.

Biopesticides kill the pests the eco-friendly way.

Fifteen to 17 sprays of BIO were made to cotton in most fields. Harvesting commenced in Nov/ Dec 2003 and finished in Feb 2004. BIO plots remained productive for about 3 weeks longer than the FP plots that senesced suddenly. Yield data was analysed statistically considering each farmer as a replication. On mean basis, BIO plots yielded 30% more cotton than the FP plots (1.87 t ha^{-1}) that received chemical pesticides and was statistically significant at 5% probability level (LSD = 0.238). Eleven of the 17 farmers harvested at least 30% more cotton in the BIO plots than in the relevant FP plots. The other farmers benefited marginally from yield. In addition, all the participating farmers saved at least Rs. 4800/- ha^{-1} (approximately US$106) in the BIO plots (even considering the cost of materials) because, on an average, the 17 farmers spent Rs. 14250/- ha^{-1} (range Rs. 8500 to Rs. 19850 ha^{-1}) on the FP plots.

Cotton in the BIO plots was protected using a protocol of biopesticides.

Forewarned is forearmed

Insect pests cause major crop losses all over the world. One of the main reasons researchers have not been effective while addressing pest problems is insufficient information about pest population dynamics.

Chickpea pods damaged by Helicoverpa.

One of the chief insect pests is the pod borer (*Helicoverpa armigera*), which infects several crops such as cereals, pulses, cotton, vegetables and fruit crops. The incidence of *Helicoverpa* shows a certain pattern in terms of population dynamics, but the pattern of peaks can change abruptly from week to week. Overlapping generations of the pest lead to unpredictable biological events. This makes it difficult to predict population densities using traditional forecasting methods.

Research efforts are underway to understand the pest dynamics by applying analytical and other techniques on pest surveillance data sets and the influence of climatic factors. Correlations between some of these factors and pest incidence, based on statistical models were developed to predict the outbreaks. Once the prediction process becomes reliable, plant protection measures can be initiated. However, the aim is to develop a functionally viable model that can be used by farmers.

A partnership research involving ICRISAT and the International Institute of Information Technology (IIIT), Hyderabad, has developed a forecasting model by employing modern information and communication technologies such as neural networks and available surveillance data on the pod borer.

Neural Network

A neural network is an interconnected set of input/output units where each connection is given an associated weight. During the "training" phase the network "learns" by adjusting the weights so as to be able to predict the labels of input samples. These networks are highly tolerant of "noisy" data, and can identify patterns even for which they are not "trained".

Data crunching

The pest surveillance data set used was collected over a period of 11 years and contains 2372 daily recordings of weather information and pest incidence. Data from the first eight years (1991 to 1998) was used for "training", and data from the following three years was used for testing. The data was boiled down into that for standard weeks, and were further transformed into a complex domain using Discrete Fourier Transform (DFT), which converts time domain periodic data into the frequency domain.

Two models were run simultaneously for the training – one for predicting a real value, and another for predicting the imaginary value. Later the predicted values are remapped to corresponding values in time domain through inverse DFT. The experiment was conducted fifteen times for each data set.

In Figure 1 the threshold line indicates the threshold larvae/plant value for the pest emergence (1.2 in this case). Whenever the actual value is greater than or equal to 1.2 we call it a "real peak". Whenever the predicted value is greater than or equal to 1.2 we call it a "predicted peak". The number of real peaks it predicts measures the performance of the neural network.

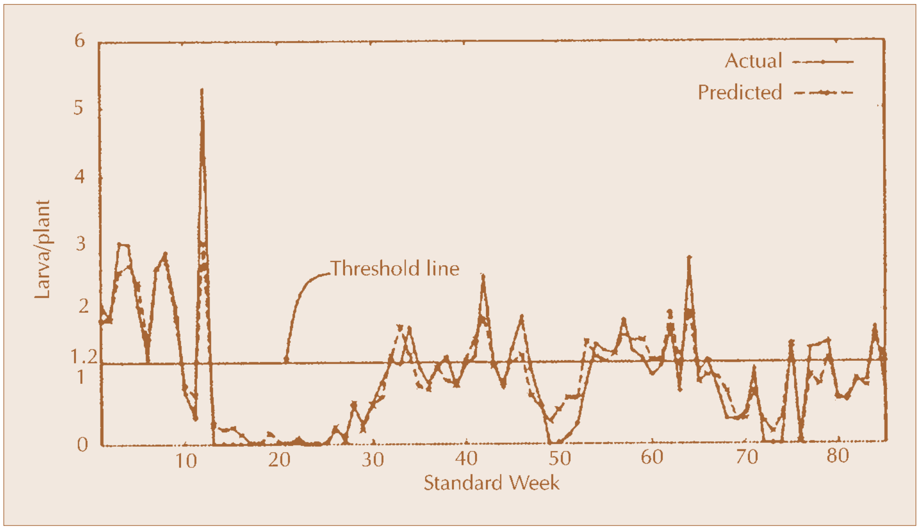


Figure 1.

Given the weather parameters of a particular week, this model can predict the larvae for the following week. It means the weather of the current week influences the larvae of the next week more than the larvae of the current week. This is because an egg period of four to five days is required in a normal situation. This study predicted 27 correct peaks out of 30 peaks indicating that the neural network can reliably predict pest outbreaks in chickpea.

Helicoverpa larvae on the rampage.

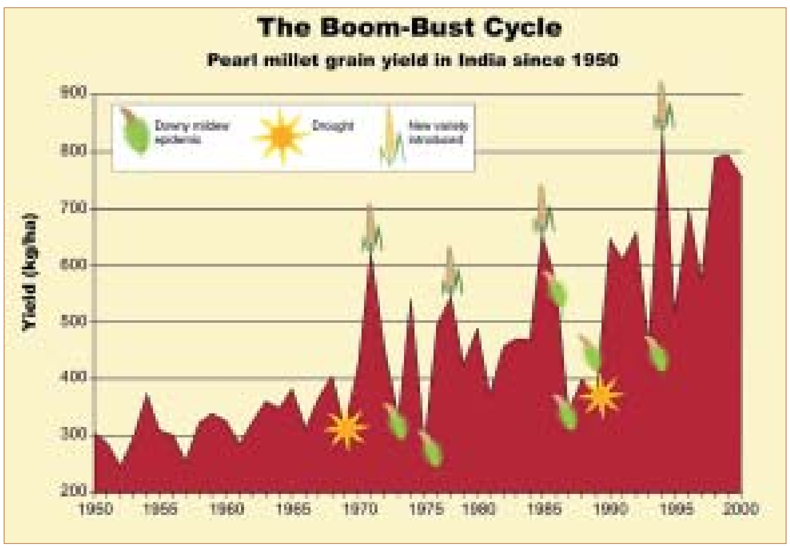
Conclusions

Using this model, one can fairly accurately predict pod borer incidence in chickpea one week in advance. These predictions can help the farmers to efficiently manage pests – they can minimize the misuse of hazardous chemical pesticides which might have been used prematurely or in quantities more than necessary. This forecast model is currently under validation during the present cropping season at ICRISAT's Patancheru site. The success of this model could also mean that the surveillance data on other pests could be used for similar predictions. Data on the groundnut leaf miner S*podoptera* and other significant pests of groundnut has been shared with the IIIT group, and we look forward to developing forecast models for these pests too.

No more Irish potato famines!

Pearl millet is a cereal grown for food grain and straw in the hottest, driest areas of Africa and Asia, almost always in rainfed conditions. When the crop is cultivated as open-pollinated varieties (OPVs), as has been the case for generations among the poorest farmers in the world, it is by definition continuously changing.

Until now, the commercial hybrid seed industry in some regions has enabled farmers to grow genetically identical pearl millets several years in succession – provided they purchase fresh seed prior to each sowing. In India, on the 9 million hectares annually sown to pearl millet, more than 60% of the crop consists of such hybrids. Although these genetically uniform hybrids are potentially higher-yielding than traditional OPVs, they are more vulnerable to a plant disease called downy mildew, which is caused by a fungus-like alga related to the one responsible for the Irish potato famine. That tragic episode resulted in complete devastation of the staple food of Ireland and resulted in mass starvation. That sad state of affairs is obviously something to avoid at all costs.



Here today, gone tomorrow! Promising hybrids one year, devastation the next. This figure shows the 'boom-bust'cycle for pearl millet hybrids in India since 1950.

Since pearl millet hybrids first reached farmers' fields in India in the late 1960s, every single hybrid that has won popularity with farmers has ultimately succumbed to a downy mildew epidemic. Thus, the adoption of popular hybrids leads to short-term gains, but also to long-term risks. Unfortunately, by the time the poorer farmers in a given region decide to adopt a particular hybrid, its days are usually numbered. This phenomenon is known as the 'boom-bust cycle'.

To reduce the risks associated with adopting hybrids, and to extend the useful economic lifespan of these hybrids, especially with the poorer producer in mind, ICRISAT and the UK's Department for International Development (DFID) have been working together to develop and apply molecular genetic tools. Using molecular markers developed at the John Innes Centre near Norwich, UK, and with support from DFID's Plant Sciences Programme, maps were made of the genomic regions controlling downy mildew resistance, straw yield potential, and grain yield under drought stress conditions. Using conventional sexual crosses and marker-assisted selection, ICRISAT breeders were able to transfer several genomic regions conferring improved downy mildew resistance to backgrounds of the two elite inbred parental lines of a very popular hybrid known as HHB 67.

And a true hybrid it was – the female parent came from Kansas State University via ICRISAT, while the male parent hailed from Haryana Agricultural University (where hybrid HHB 67 itself was developed). The performance of these 'improved parents' were compared with those of their original versions in both greenhouse and field disease screens, and in multi-locational yield trials that were conducted under rainfed

What is linkage drag?

This term is used by scientists to refer to the situation that occurs when the main ingredient is affected – either positively or negatively – by another ingredient that comes along with it. The taste of whisky, for example, can be enhanced by adding a little soda, whereas the addition of lemonade masks its flavor. Both the soda and the lemonade could be thought of as 'linkage drags', with the first being favorable and the second not (at least for the whisky connoisseur). In plant breeding, the trick is to find and exploit favorable linkage drag while minimizing any potential negative effects.

conditions during the rainy seasons of 2001, 2002 and 2003. During the latter two years irrigated drought nursery trials were also conducted during the hot dry seasons at ICRISAT-Patancheru.

Two derivatives of the elite male (pollinator) parent H 77/833-2 (ICMR 01004 and ICMR 01007) exhibited excellent resistance to downy mildew. What's more, their hybrids performed as well or better than those of the original pollinator for grain and stover yield. This success was accompanied by favorable linkage drag for several traits, including 1000-grain mass, panicle length, plant height and rust resistance.

Hybrids based on crosses involving the two new derivatives of H 77/833-2 have entered their third and final year of trials under the auspices of the All India Coordinated Pearl Millet Improvement Project in the main pearl millet areas of India, where mean annual rainfall is less than 400 mm. The derivatives were compared with the original HHB 67, and to each other, in about 100 farmer-managed on-farm trials in Haryana during the 2003 rainy season. This followed their successful evaluation in on-station trials in 2002, when they exhibited marginal grain yield superiority and substantially better downy mildew resistance than HHB 67 without sacrificing the early maturity that led to this hybrid's popularity. In the on-farm trials conducted in Haryana during the 2003 rainy season, the new versions of HHB 67 demonstrated clear grain yield advantages over the original.

It is anticipated that at least one of these two hybrid derivatives (most likely the higher-yielding, rust-resistant version based on pollinator ICMR 01007) could be released in early 2005 as a replacement for HHB 67 – hopefully before it succumbs to a downy mildew epidemic, just like the blight that wiped out potatoes in Ireland nearly 160 years ago.

Considering that HHB 67 is grown so widely by poor farmers in India, its timely replacement could prevent an epidemic. The grain yield losses so avoided, in even a single year, would *exceed* the total value of research funding by DFID to date (£3.2 million) for development and application of tools for pearl millet marker-assisted breeding. All future benefits from this research by ICRISAT, its DFID-supported partners in the UK, and collaborating national program partners in India could then be considered profits to society as a whole.

Managing watersheds in Southeast Asia

ICRISAT's unqualified success with watershed management in India is well known. Research conducted with an array of partners from various governmental and nongovernmental organizations has had resounding results that have benefited thousands of Indian farmers.

What is less known is that these successful technologies have been shared with national program partners in Southeast Asia; specifically, in Thailand and Vietnam.

DOA's Thawilkal Wangrahart with ICRISAT partner Prabakhar Pathak at their office in Khon Kaen.

Mr Sangchan is keen to adopt new technologies – as long as they work! This IPM initiative involves funneling molasses into discarded water bottles to attract insect pests. This simple but effective trap costs nothing, and DOA supplies the molasses at only 3 bhat per kg.

Thailand

Tad Fa is a village 156 km west of Khon Kaen, in northeastern Thailand. Traditionally a forest area, the area is typified by hills, many of them quite steep. Unsuited to rice cultivation because of the lack of flat land, farmers have had to make do with marginal crops. The topsoil, which is nutrient poor, erodes quickly during the monsoon when the jungle cover is cut down to make room for an expanding population. This combination of problems was exactly what ICRISAT was looking for, once it became clear that Thailand's Department of Agriculture (DOA) was interested in adopting the watershed technologies that had proved so successful in India. Besides DOA, another Thai government agency, the Land Development Department (LDD), is actively involved in the watershed project. The work receives solid support from the Asian Development Bank (ADB).

ICRISAT began working in the area in 1998 – initially in Tad Fa and later in other villages. Mr Nuek Sangchan, who lives near Tad Fa, is a progressive farmer who has been working with the project since its inception. Energetic at 60, he is an inspiration to far younger farmers. One such protégé is Mr Veera Yandee, whose interest in land development and fruit trees has inspired him to take the lead in technology transfer to other farmers. Together, Nuek and Veera have been able to convince many of their neighbors to adopt the new technologies.

What improved technologies have Mr Sangchan and his neighbors adopted? The list is an interesting mixture of agronomic practices and technology adoption.

- *Contour cultivation.* All things being equal, a farmer who has to do his own tilling on a sloping field will take advantage of gravity by plowing downhill. Except that all things are *not* equal. Downhill plowing leads directly to erosion because there is nothing to prevent soil run-off. Contour cultivation – plowing perpendicular to the slope – is harder work, but the proof of the pie is in the eating. And when vegetative barriers like vetiver grass and fruit trees are part of the package, precious soil is retained, and the slope becomes a series of terraces, with each terrace supporting a robust crop. During 2003, 197 hectares in Tad Fa (68% of the total area) were planted with improved practices, resulting in higher productivity and less soil loss.

Contour cultivation has turned this once marginal slope into a productive, income-generating field.

- *No tillage system on high slopes.* During 2003, 5–6 hectares were planted with no-till technology by eight farmers, including Mr Sangchan. This resulted in lower land degradation.

- *Improved crops and cropping systems.* Seven farmers adopted rice bean (*Vigna umbellata*), a locally popular legume, as a relay crop with maize. Another 17 farmers sowed rice bean and 35 farmers cowpea as sequential systems after maize.

- *New crops.* Confectionery sunflower was introduced during 2003 to improve farmers' income. Expansion of fruit tree cultivation, including lychee and jackfruit, in and around Tad Fa, has also become important. DOA donated 1500 fruit trees to Tad Fa farmers to arrest soil run-off and enhance incomes.

The lives of the Viriyaparb family have been significantly enhanced through application of the new watershed management techniques introduced by the DOA, LDD and ICRISAT partners, as the smiles on the younger members of the family attest!

- *Intercropping.* Intercropping fruit trees with bananas has resulted in better income and better survival of fruit trees. Bananas grow quickly, giving farmers an interim cash crop while their slower-growing fruit trees mature. Growing fruit trees with various annual crops gives farmers more options.

- *Home-made inputs.* Local water harvesting and mulching provide farmers with key inputs without significant cost.

Says Dr Thawilkal Wangrahart, DOA's Coordinator of the ADB-ICRISAT Project, 'The interventions introduced by ICRISAT have made a real difference in the project villages. Our partnership with ICRISAT and the support of the ADB have made it possible for farmers to improve their lives.'

Mapping the strategy. Maps of the watershed areas are essential in planning the optimal use of slopes and lands.

Vietnam

The situation in Vietnam, an agrarian country where rice is by far the most important crop, is similar. Most of the population lives in the vast river deltas of the lowlands where rice farming is the predominant occupation. But as the population expands, more people are moving into the midlands and highlands, where, as in Thailand, rice farming is not practical.

Poverty, exacerbated by population pressure, is a serious problem in Vietnam. The average land holding in the delta is only 600 square meters, obliging the government to devise schemes to relocate farmers to the midlands, where the average altitude is 1500 meters. Before 1965, few people lived in the midlands, but after decades of out-migration from the delta, about 33% of the country's population now lives in the midlands and highlands. Unfortunately, a suitable policy was not put into place, and this led to many problems. Population growth, a robust 2.5% in the lowlands, was 3.5% in the uplands.

Thriving on adversity. Working together, VASI and ICRISAT have found ways to make farming a prosperous activity in Vietnam's uplands.

Landholdings are relatively large in Vietnam's midlands, averaging about 3000 square meters (six times the average in the delta). But along with larger holdings come larger problems.

Vietnam's rainfall is abundant, averaging 2500 mm, about triple the norm for the semi-arid tropics, where most of ICRISAT's work is conducted. But the rain can be intense, leading to severe soil erosion. Deforestation compounded this problem. Also, as in other countries within the humid tropics, between monsoons conditions become drought-like. Carrying water long distances and using it sparingly has been a part of life for dwellers of the midlands for generations. Clearly, improved technologies were badly needed. The Vietnam Agricultural Science Institute (VASI), which has enjoyed a long and productive relationship with ICRISAT's crop improvement scientists, decided to tap the center's expertise in natural resource management.

Nguyen Van Vinh (on left), seen here with one of his neighbors, is a progressive farmer from Huong Dao and an enthusiastic spokesman for the new technologies.

VASI and ICRISAT knew that their goal would not be simple to achieve. Production needed to be stabilized at a higher level, and traditional farming systems would need to diversify. Studies of land use capability, and decisions about new crops to be introduced – including fruit trees and other agroforestry initiatives – needed to be made. The project experimented with intensified production through techniques like intercropping and promoted such micro enterprises as duck and pig husbandry to foster increased employment.

Mr Nguyen Van Vinh lives in Huong Dao commune, Tam Duong District, Vinh Phuc Province, about 50 km northeast of Hanoi. Like Mr Sangchan in Thailand, Mr Vinh has embraced the new technologies with enthusiasm. His farm, like those of his neighbors, is characterized by red soils with low pH (4 to 4.5), acidity and aluminum toxicity. These problems, added to those of erosion and long dry summers, made life exceedingly difficult for him. But with the introduction of technologies like the ones in Thailand, prosperity no longer seems to be a distant dream. Indeed, he feels that it is just around the corner.

Cementing the partnership. ICRISAT's partners from Thailand and Vietnam in a social setting in Hyderabad, India. Clockwise from 6:00: Dr A Ramakrishna and Dr P Pathak, ICRISAT; Mrs Pranee Srihaban, LDD; Dr Le Quoc Doanh and Dr Tran Dinh Long, VASI; Dr Thawilkal Wangrahart, DOA; Dr SP Wani, ICRISAT.

Le Quoc Doanh, Deputy Director General of VASI and Director, Northern Mountainous Agricultural Research Center is extremely pleased with the project's denouement. He and his team, like their peers in Thailand, have developed an extremely close rapport with ICRISAT's natural resource management scientists.

Thailand and Vietnam may not be semi-arid, but the watershed management technologies refined in drier areas are clearly applicable in niche situations, and ICRISAT's partnerships with these rapidly developing Southeast Asian nations, aided by the ADB's ongoing support, has enriched the lives of hundreds of farming families.

Making markets work for farmers in eastern Africa

Poverty is rife in eastern Africa, where over half the rural population is extremely poor. Addressing this state of affairs, ICRISAT has allied itself with an array of partners to reduce poverty through a market-driven strategy. The strategy is based on intensified cultivation of ICRISAT's legume crops – chickpea, pigeonpea and groundnut – and linking farmers to markets where these commodities are sold.

The process involves producing seed on research fields provided by national partners, then handing the seed over to farmer organizations. These groups distribute seeds to selected farmers for multiplication, who then sell the seed back to the farmer groups, who in turn sell it to a wide array of farmers. Finally, the farmers pool their produce and sell it to traders in regional and international markets. The strategy is working, and some of the poorest farmers in the region are finally seeing light at the end of the tunnel.

Getting the right product

The first step was to find products that satisfied consumer taste but also yielded more than the local landraces. Chickpea was a particularly attractive possibility because it commands high prices – especially the kabuli types which sell for two to three times the price of desi types. The approach was to move quickly from on-station to on-farm trials and subsequent release.

Chickpeas were grown in both mid altitude areas in black soils and in cool areas. Over 500 short- and medium-duration varieties were introduced from India. Once the most suitable varieties were identified, they were constituted into nurseries and planted at Kabete, Kenya. Chickpea seed was also provided to national programs in Tanzania and evaluated in Arusha and Mwanza.

The results were superb. Grain yields of the highest-yielding varieties were over 4 tons per hectare and more than 80% of the entries out-yielded the local checks in both countries.

Donors visiting a chickpea field in Mbeere.

Finding the right place

In Kenya, trials were conducted in the hot eastern part of the country and in the cooler Rift Valley. In Tanzania, trials were conducted in Mwanza and Shinyanga provinces. In both countries, farmers liked the improved varieties because of their earliness, large pods and seeds, and uniformity.

It was agreed that four varieties would be grown in both Kenya and Tanzania. Only one of these varieties, ICCV 97105, is a desi type. The other three are kabulis: ICCV 92318, ICCV 96329 and ICCV 95423.

Making it happen

The process by which farmers are linked directly to markets consists of six steps.

1. Foundation seed is produced by ICRISAT on research fields provided by KARI and the University of Nairobi.
2. The seeds are handed over to farmer organizations called Producer Marketing Groups (PMGs).
3. PMGs distribute seed to a few dozen farmers for multiplication.
4. These farmers produce high quality seed (3 tons in the first year) and sell it back to the PMGs.
5. PMGs sell seed to farmers.
6. Farmers pool their produce and market it to traders.

How does the commercialization process work?

First, chickpea farmers take their seeds to the nearest PMG collection center.

Second, seeds are gathered at collection centers.

Third, sacks of chickpeas are loaded into lorries.

Fourth, sacks of chickpea are stacked in warehouses, awaiting export to international markets.

The example cited deals with chickpea in Kenya and Tanzania, but the other two legumes are also important to farmers, NGOs, national program partners and donors – not only in eastern Africa but in southern and western Africa too. Similar projects are under way with groundnut and pigeonpea in Mozambique, Malawi and Mali.

Measurable impact

In the first year in Kenya, farmers were able to double their prices for desi and to increase prices for kabuli chickpeas by 60%. Higher productivity linked with higher prices brings significantly higher profits, an encouraging situation for farmers seeking new income sources. The enthusiasm displayed by farmers when they shipped 120 tons of chickpeas to market, and were paid cash on the spot by equally delighted traders, was heartening. As more and more farmers realize how much money can be made, more and larger such scenarios can be expected.

Linking technology development to the market is clearly the road ahead. As long as the right varieties are made available, sustainable systems of seed supply are established, and links with traders are strengthened, there is no reason the farmers of eastern Africa cannot reach hitherto unthinkable levels of prosperity.

Planned obsolescence

After providing the initial foundation seed, ICRISAT's involvement is no longer needed. ICRISAT's role at this point is simply to monitor the scenario, introducing new varieties as and when required, and providing technical and marketing information on demand. *The farmers themselves are in control.*

Sorghum, a crop of substance

Sorghum [*Sorghum bicolor* (L.) Moench] is the world's fifth most important cereal crop by area after rice, wheat, maize and barley. A staple food crop in the semi-arid tropics of Africa, Asia and Latin America, its importance as a fodder and feed crop for livestock has steadily increased over the last two decades.

Macia—An early-maturing, high-yielding and highly popular variety in Eastern and Southern Africa.

Low productivity of sorghum in the 1970s was the result of management practices and traditional cultivars, exacerbated by biotic and abiotic stresses. Improving the crop's productivity was clearly necessary.

ICRISAT, in collaboration with national agricultural research systems (NARS), advanced research institutes and sister CGIAR centers, has successfully improved sorghum through both traditional genetic improvement, and through integrated genetic and natural resource management practices. To date, a total of 194 improved cultivars have been released and adopted worldwide.

S 35 – making friends in Chad

"When rains do not come on time or when they stop too soon, our own varieties give us nothing, so we sow this one", says farmer Toralet of Niergui village in Chad, displaying a few panicles of S 35. "This is the sorghum that never fails" he adds.

S 35, a high yielding sorghum cultivar widely cultivated in several African countries.

Says Issaka, another farmer from the same village "I used to sow two hectares of my own variety each year in order to feed my family. Now I sow only one hectare with S 35, and I grow vegetables on half of the other hectare."

For Bouda, a farmer from the village of Tchigali II, S 35's early maturity is a real advantage, not just because it helps escape terminal drought, but because it reduces the hunger period before the next harvest. "Ever since I first tried S 35 variety in 1992, I sow half a hectare of it each year. This way I can feed my family even as I wait for the sorghum of our ancestors to mature", he explains.

More land for other crops

In India, because of increases in sorghum productivity, nearly 6 million ha (35% of the 1972 sorghum area) has been made available to farmers to diversify into high-income cash crops. In Africa, the sorghum area has increased by 9 million ha, and coupled with increased productivity, total production has increased by 10 million tons (3.4% annually). This is an incalculably important contribution to food security.

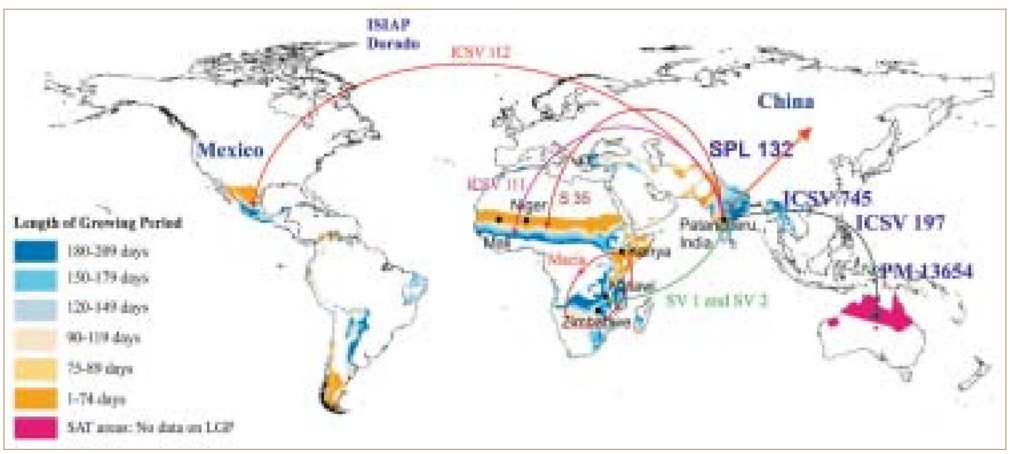
Economic returns

The cost-benefit production ratios of improved sorghum cultivars are 1:1.25 in West and Central Africa and 1:1.4 in India. The net present value (NPV) from a single ICRISAT-derived cultivar, S 35, was estimated at US$ 15 million in Chad and US$ 4.6 million in Cameroon, with internal rates of return (IRR) of 95% for Chad and 75% for Cameroon. Improved cultivars in Mali generate an NPV of US$ 16 million with an IRR of 69%. The adoption of improved cultivars in eight SADC countries contributes an additional US$ 19 million annually to the incomes of smallholders. In Zambia, the IRR from the adoption of a single cultivar, ICSV 88060, is estimated at 15%, and a whopping 22% in Zimbabwe.

Sharing the benefits

International agricultural research often produces spillover benefits for developed countries. For example, the gains in productivity in midge-endemic areas of Australia through the adoption and use of three midge-resistant cultivars introduced from ICRISAT-Patancheru are estimated at 2.5% annually. This translates into a cost reduction of US$ 4 per ton and a cost savings of US$ 4.7 million at current average production levels. These benefits are well in excess of Australia's financial contribution to ICRISAT.

Spillover impacts from one region to another are also significant. Macia, for example, a variety developed at ICRISAT-Bulawayo in Zimbabwe in 1989, was released in Mozambique that same year, in Botswana in 1994 (as Phofu), in Namibia in 1998 and in Tanzania in 1999. Similarly, several ICRISAT varieties developed in India were released in other Asian countries.



Spillover impacts of important sorghum research products.

ICRISAT was obliged to shut down its operations in Latin America during the early 1990s. However, ICRISAT-derived varieties and hybrids have continued to be released by Central American governments, and occupy one fifth of the sorghum area in four Central American countries.

Pulling out the stops

Resource-poor farmers potentially gain an estimated US$ 736 million by adopting cultivars that resist biotic and abiotic stresses. Many released cultivars are also nutritionally rich in crop residues for livestock. The increased grain productivity of tall,

Stem borer resistant transgenic sorghum shoots developed at ICRISAT-Patancheru.

dual-purpose cultivars, together with nutrient-rich crop residue, ensures food and feed availability.

Advances made in identifying quantitative trait loci (QTLs) for resistance to shoot fly, *Striga,* and drought (the 'stay-green' trait) are positioning ICRISAT and partners to bring about rapid advances in breeding.

ICRISAT is the first research institute in the world to develop stem borer-resistant transgenic sorghums. This work is already in an advanced stage and will soon be ready for greenhouse testing.

ICRISAT's role in leveraging the partnerships in research on alternative uses of sorghum, such as poultry feed, syrup and ethanol production, is paving the way for utilization of the marketable surplus of high-yielding cultivars.

New partners, new money

ICRISAT is the first CGIAR center to significantly tap the resources of private seed companies for public research on hybrid parents development. The ICRISAT-led Sorghum Consortium netted US$ 0.2 million during the 2000-03 period. Also, tie-ups are worked out with two private parties to incubate ethanol production technology from sweet sorghum cultivars developed by ICRISAT.

Farmers of Andhra Pradesh and Karnataka in India are benefiting from seed production of JKSH 22.

The popularity of private sector hybrids, most of which are based on ICRISAT-developed parental lines or their derivatives, has engendered significant seed production activities. An annual income worth over US$ 300,000 was obtained by villages in Andhra Pradesh and Karnataka states in India from seed production of JKSH-22 hybrid alone during the past seven years. In the last three years, a total of 29,800 tons of certified hybrid seed of ICRISAT-private sector partnership hybrids has been produced, resulting in a total income of US$18.8 million to Indian farmers.

Another novel development on the sorghum front has been the utilization of sorghum attacked by grain mold. Because mold-affected sorghum is not safe for human consumption, it fetches a very low price in the market. But help has come from a surprising source. The Seagram's company has found that mold-infected sorghum is perfectly fine for distilling as whisky. In fact, specialists reported that diseased sorghum actually yields a superior product! Now farmers are able to sell a product that previously spelled economic ruin for them.

Sorghum has indeed been transformed from a subsistence crop to one of substance.

VASAT: Sharing the right information with the right people at the right time!

When it comes to coping with drought, sharing the right information and knowledge at the right time can mean the difference between life and death for more than 800 million people of the dry tropics.

Rural communities are better able to cope with drought if they have access to timely information and knowledge. This enables them to see the warning signs and effectively coordinate with local administration and development agencies to handle the situation.

Nature and concept

The Virtual Academy for the Semi-Arid Tropics (VASAT) is a strategic information, communication and non-formal distance education coalition led by ICRISAT to help vulnerable rural communities and their intermediaries cope better with drought and desertification. It explores the interface of information and communication technologies (ICTs) with open and distance learning (ODL) for innovative information and knowledge sharing.

Rural women getting informed through the Internet.

VASAT's main focus is to collect and process location-specific, demand-driven content, balancing generic and location-specific information, which can be utilized by rural communities.

The MS Swaminathan Research Foundation in India has tested a 'hub-and-spokes' model to implement this concept. The hub is located in a large village with access to good communication infrastructure. Local professionals, working through the hub, link surrounding villages with sources of information and knowledge using the Internet or telephone. The hub connects to the Internet, while the villages connect using terrestrial wireless technologies. This model is being adopted by VASAT for South Asia, particularly India.

In Africa, the interface of low-frequency and solar powered FM community radio stations with new digital radio satellite technologies has been established by RANET (a RAdio and InterNET international collaboration). These community radio stations serve as VASAT's hubs. They are complemented by trained community broadcasters and multidisciplinary experts from the VASAT coalition.

By building on these models, VASAT generates International Public Goods on innovative information and knowledge sharing.

Content is being uploaded in a global learning objects repository maintained by ICRISAT and the VASAT coalition at www.vasat.org. This is accessed by national and local partners, and adapted for rural communities and intermediaries throughout the dry tropics.

VASAT's coalition

In February and August 2003, two roundtable consultations were held in South Asia, and in West and Central Africa respectively to establish VASAT. In India, ICRISAT, MSSRF and the Indira Gandhi National Open University (IGNOU) comprise VASAT's anchors. The principal partners are major open universities and agricultural research agencies like the Central Research Institute for Dryland Agriculture (CRIDA) of the Indian Council for Agricultural Research (ICAR). A number of leading national organizations are also involved such as the ICAR system, National Institute of Agricultural Extension Management, National Institute of Rural Development and Council for Advancement of People's Action and Rural Technology.

Getting drought information through radio in Niamey.

In West and Central Africa, a group of inter-continental, regional, national and local organizations comprise the VASAT coalition among which are: Africare, African Centre of Meteorological Applications for Development (ACMAD), African Virtual University-Universite Abdou Moumouni (AVU-UAM), Comité Permanent Inter-états de lutte Contre la Sécheresse dans le Sahel Centre Régional (AGRHYMET), Conseil Supérieur de la Communication (CSC), Echos du Sahel, First Voice International, Freeplay Foundation, Helen Keller International (HKI), Institut National de Reserches Agronomiques du Niger (INRAN), National Oceanic and Atmospheric Administration (NOAA), International Research Institute for Climate Prediction (IRI), Oxfam-Québec (OXFAM), Radio Communautaire Marhaba de Kahe, and United Nations Fund for Population Activities (UNFPA).

The Commonwealth of Learning (COL), an inter-governmental organization promoting open and distance learning, provides technical advice.

VASAT's organization

Based on the model of the Internet Engineering Task Force, (and partly based on voluntary adherence), VASAT created a faculty of experts by inviting corporations in India and abroad as technology resource groups. Further, by invoking successful models of open learning and blending them with virtual groups, rural youth and women of SAT will acquire the capacity for knowledge needed to overcome the effects of drought in the long term.

First steps

Pilot rural hubs have been established in Andhra Pradesh, India and regional meetings are in progress to establish more hubs. Each is hosted by an NGO already engaged in the area.

In West and Central Africa, an Internet-supported community radio station located about 20 km from ICRISAT's regional hub in Niamey, Niger has been identified as the pilot site and social laboratory. Two others will also be established in Niger in 2004. Community information needs analysis in the social laboratory has just been completed. VASAT is thus a new and useful tool in the arena of rural development.

Development Investor Partnerships Initiated in 2003

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

Donor	Project	Collaborators
Asian Development Bank	Participatory watershed management for reducing poverty and land degradation in the semi-arid tropics	Central Research Institute for Dryland Agriculture (CRIDA), BAIF Research and Development Foundation, Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), Indian Institute of Soil Science (IISS), M. Venkatarangaiya Foundation (MVF), Drought Prone Area Programme (DPAP), Andhra Pradesh Rural Livelihood Project (APRLP), India Vietnam Agricultural Sciences Institute (VASI), Vietnam International Water Management Institute (IWMI), Sri Lanka Department of Agriculture (DOA), Khon Kaen University (KKU), Thailand Chinese Academy of Agricultural Sciences (CASS), Yunnan Academy of Agricultural Sciences (YASS), Hainan Academy of Agricultural Sciences (HAAS), People's Republic of China University of Georgia, USA
Australia	Genetic strategies for improving chickpea yields in South-Western and Central Queensland	Grains Research and Development Corporation, Australia
	Improved fertilizer recommendations and policy for dry regions of Southern Africa	CSIRO, Australia; Department of Agricultural Research, South Africa; Progress Mills, South Africa
Canada	Situational analysis and strengthening of ICT capacity in Afghanistan	International Development Research Centre, Canada
	Seed Support for VASAT	Commonwealth of Learning, Canada
	International Symposium for Sustainable Dryland Agriculture Systems	International Development Research Centre, Canada
CFC	Expert meeting on uses of sorghum and pearl millet in Asia	Asian NARS
	Development of sustainable groundnut seed systems in West Africa	NARS of Niger, Mali, Nigeria, Senegal
European Commission	Regional Programme to Support Agricultural Research in East Africa — the Soil and Water Management Research Network (SWMnet)	ASARECA, Uganda
	Regional Programme to Support Agricultural Research in East Africa — the East and Central Africa Regional Sorghum and Millet Network (ECARSAM)	ASARECA, Uganda

Donor	Project	Collaborators
FAO	Empowerment through Technology - Synthesis of Lessons Learned about Gender Dimensions in Adoption of Groundnut Production Technology, Poverty Reduction and Build-up of Social Capital	NARS, NGOs in India
	Monitoring and assessment of agricultural relief programs in Zimbabwe	University of Zimbabwe, NARS and NGOs in Zimbabwe
	Impact of HIV/AIDS on gendered information flows related to seeds among rural producers	NARS, NGOs in Mozambique
	Establishment and implementation of Junior Farmer Field Schools in Zimbabwe	Farming communities in Zimbabwe, Catholic Relief Services, Zimbabwe
	Grant in support of growing fodder crops in Midlands, Matabeleland North and South provinces	Farming communities in Zimbabwe
Germany	Enhancing access to genetic diversity through scaling up participatory plant breeding: Roles of different types of farmer and development organizations in Mali.	University of Hohenheim, Germany; Institut d'economie rurale (IER), Point Sud, Centre for Research on Local Knowledge, Univeristy of Bayreuth, Association des Organisations Professionalles des Paysans (AOPP), Farmers and Farmer Organizations, Mali.
IFAD	Semi-Arid Tropics and Rural Poverty: the Case of India	NARS, NGOs in India
India	Support for establishment of Technology Business Incubator	Department of Science & Technology, India
Italy	Technical support and monitoring of seeds relief in Hwange district	Coordination of Organizations for Voluntary Service (COSV), Italy
Mozambique	a) Disseminate methodology for assessing seed requirement in districts susceptible to natural disasters; b) Increase the adoption of new varieties through links with the seed market	Ministry of Agriculture and Rural Development, Republic of Mozambique.
Netherlands	Development of mycopesticide formulations of *Beauveria bassiana* and *Nomuraea rileyi* for insect pests of vegetable crops	Andhra University, India; Institute of Public Enterprises, India
OPEC	Development of salinity-tolerant sorghum and pearl millet cultivars for enhanced productivity on saline lands	International Centre for Biosaline Agriculture, UAE
	Harnessing Technology for Sustainable Development: Economic Empowerment of Poor Groundnut Farmers in Asia	Asian NARS

Donor	Project	Collaborators
Rockefeller Foundation	Support to international colloquium "Bridging the technology divide — Biotechnology alliances and new architecture of innovation"	CGIAR, USA; Sun Micro Systems, USA; Applied Biosystems, UK; Avestha Gengraine Technologies Pvt Ltd, India.
	Guinea sorghum hybrids: Bringing the benefits of hybrid technology to a staple crop of Sub-Saharan Africa	Institut D'Economie Rurale (IER), Mali. Institut de l'Environnement et de Recherches Agricoles (INERA), Burkina Faso
UK	Enhancing chickpea establishment and productivity through seed priming	NARS in Kenya
	Enabling rural poor for better livelihoods through improved natural resources management in SAT India	Central Research Institute for Dryland Agriculture (CRIDA), India
	Support for emergency agricultural recovery program for vulnerable households	World Vision International, Zimbabwe, CARE International, Zimbabwe, NGOs, Zimbabwe
	Exploring market opportunities through a research, industry and user coalition: sorghum poultry feed	Acharya NG Ranga Agricultural University, Federation of Andhra Pradesh Farmers' Association, Andhra Pradesh Poultry Federation, Janaki Feeds, India
	Participatory multiplication of two dual purpose groundnut varieties	NARS in India
	Aflatoxin contamination in groundnut in Southern India: Raising awareness and transferring and disseminating technologies to reduce aflatoxin	University of Reading, UK; Acharya NG Ranga Agricultural University, India; NGOs in India
	Evaluation of the effects of plant diseases on the yield and nutritive value of crop residues used for peri-urban dairy production on the Deccan Plateau in India	Natural Resources Institute, UK; International Livestock Research Institute, Kenya; Acharya NG Ranga Agricultural University, India; University of Greenwich, UK
USA	Comparative legume genomics: Translating progress in model systems for impacts in staple crops of the semi-arid tropics	University of California-Davis, USA
	Comparative analysis of functional and anonymous diversity in pearl millet and sorghum: A foundation for accelerated direct (gene-based) and indirect (marker-based) selection	University of Georgia, USA
	Support to Household Nutrition Garden program	Development Alternatives Inc., Zimbabwe; NGOs and Farmer Communities in Zimbabwe
	Developing community-based water-energy services and markets: a pilot project	US Department of Agriculture, USA; IWMI, Sri Lanka; NARS and NGOs in India
	Developing the gum arabic sector in Niger	USAID; Farmer Communities, Private Exporters in Niger

Donor	Project	Collaborators
	Introduction of the African market garden to the semi-arid tropics of West and Central Africa	USAID; NARS in West and Central Africa
	Sahelian eco-farm	USAID; NARS in West and Central Africa
	Carbon from communities: A satellite view Measuring and assessing soil carbon sequestration by agricultural systems in developing countries	Soil Management CRSP, USA
Consortia of donors (via CGIAR Systemwide Programs)		
CIAT	Soil fertility in the communal farming lands of Zimbabwe	TSBF, Kenya
IWMI	Validation of Drivers for Bright Spots in the Area of Watershed Management and Joint Forest management in India (Comprehensive Assessment [CA] of Water Management in Agriculture)	NARS in India
	Water scarcity and food security in tropical rainfed water scarcity systems: a multi-level assessment of existing conditions, response options and future potentials	The International Water Management Institute (IWMI), Sri Lanka The International Institute for Applied Systems Analysis (IIASA), Austria UNESCO-IHE Institute for Water Education (UNESCO-IHE), the Netherlands National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), India Central Research Institute for Dryland Agriculture (CRIDA), ICAR, India National Center for Agricultural Economics Policy Research Institute (NCAP), India Vietnam Agricultural Sciences Institute (VASI), Vietnam Disaster Management Training and Education Center (DMTEC), South Africa Centro Internacional de Mejoramiento de Maizy Trigo (CIMMYT), Mexico
	Productivity of Water in Agriculture and Interacting Systems: Approaches and Options for Eastern Africa (Comprehensive Assessment [CA] of Water Management in Agriculture)	Sokoine University of Agriculture, Tanzania Univesity of Makelle; University of East Anglia
World Bank	Rehabilitation of CGIAR Global Public Goods Assets	NARS
	Support for partnership in rural development	NARS
	Information and Communication Technology (ICT)/Global Public Goods (GPG) Program: Applying ICT and KM for Excellence in Science – a Virtual University for the Semi-Arid Tropics.	NARS

Donor	Project	Collaborators
	Information and Communication Technology (ICT)/Global Public Goods (GPG) Program: Video Conferencing Systems for Project Collaborators.	NARS and CG Centers
CP HarvestPlus – IFPRI/CIAT	Genetic engineering of groundnut for enhanced ß-carotene production to combat vitamin A deficiency in the semi-arid tropics	National Institute of Nutrition, India
	Genetically enhanced micronutrient-dense pearl millet grains for improved human nutrition in the Western Africa region and India	National Institute of Nutrition, India; Center for Economic and Social Studies, India; National Center for Agricultural Economic Policy Research (NCAP), India; Helen Keller International, Mali
	Identification of Micronutrients and Vitamin A Precursor (ß-Carotene) Dense-Sorghums for Better Health in Western and Central Africa and Central India	National Institute of Nutrition, India; Center for Economics and Social Studies, India; National Center for Agricultural Economics Policy Research, India; Wageningen Agricultural University, The Netherlands.
	Enhancement of essential amino acids methionine and threonine by metabolic engineering for improved nutritional value of pigeonpea (*Cajanus cajan* L.Millsp.)	National Institute of Nutrition, India
Others		
Catholic Relief Services	Community seed production and soil fertility management through FFS	Farming Communities in Zimbabwe; NARS in Zimbabwe
	Increasing returns to relief distributions through soil fertility management and FFS	Farming Communities in Zimbabwe; NARS in Zimbabwe
Maharashtra Hybrid Seeds Company (MAHYCO)	Development of high yielding widely adopted disease resistant pigeonpea hybrids and their seed production technology	NARS in India
McKnight Foundation	Workshop on “Millet and sorghum-based systems in West Africa: Current knowledge and enhancing linkages to improve food security”	NARS in West Africa
PLAN International	Collaborative project on groundnuts and pigeonpeas	NARS and NGOs of Malawi

Attributed support for core programs from Canada, Commission of the European Communities (CEC), Iran, Japan, France, South Africa and UK is not listed but is included in the Financial Summary

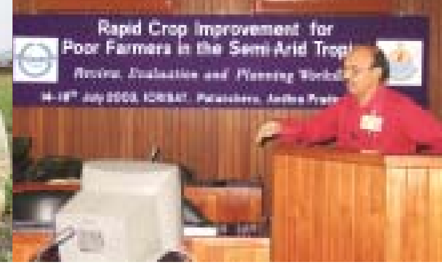
Research Scholars			
Names	**Country**	**Degree**	**Topic**
Completed during 2003			
R Aruna	India	PhD	Morphological and molecular diversity analysis, and genetic enhancement of pigeonpea (*Cajanus cajan* L.) for pod borer resistance through wide hybridization
Ylva Bessmer	USA	Phd	Arbuscular Mycorrihzal Fungi in smallholder systems
Rumbidzai Chitombi	Zimbabwe	MSc	Social Sciences
G Sunitha Dayal	India	PhD	Genetic Transformation Studies In Pigeonpea
Mildred Murandu	Zimbabwe	BSc	Biochemistry
Ronica Muyambo	Zimbabwe	BSc	Biological Sciences
Joice Ndlovu	Zimbabwe	BSc	Genetics Biological Sciences
Helen Ncube	Zimbabwe	BSc	Interactions between animal manure and soil texture
L Sivarama Prasad	India	PhD	Synteny analysis of rice and sorghum
E Sreelatha	India	PhD	Stability, Inheritance and Mechanisms of Resistance to *Helicoverpa armigera* (Hub.) in Chickpea
Gertrude Tawodzera	Zimbabwe	BSc	Applied Biology
Martine Van Wolfswinkle	Netherlands	MSc	Soil water and legumes
Continuing during 2003			
Ch Anuradha	India	PhD	Genetics and Molecular Marker Studies in Chickpea (*Cicer arietinum* L .)
Hameeda Bee	India	PhD	Studies on agriculturally beneficial microorganisms: Diversity and dynamics in cropping systems contrasting for crop residues and pest management
Surinder Kumar Gulia	India	PhD	QTL mapping and marker assisted improvement of downy mildew resistance in ICMB 89111
D Anitha Kumari	India	PhD	Mechanisms and diversity of resistance to Helicoverpa in pigeonpea
Mukesh Kumar	India	PhD	Effects of cytoplasmic male - sterility on expression of resistance to Sorghum shoot fly
P Sri Lakshmi	India	PhD	Characterization of Isolates of *Trichoderma* spp. for their biocontrol ability against *Aspergillus flavus* in groundnut
G Manisha	India	PhD	Development of new PCR-based sequence specific co-dominant markers for groundnut and molecular genetic characterization of ICRISAT groundnut germplasm
H Abdullahi Nur	Somalia	PhD	Variability in *Aspergillus flavus* and biocontrol of aflatoxin contamination in groundnut
T Nepolean	India	PhD	QTL mapping of grain and stover yield in pearl millet
Latha Nagarajan	India	PhD	Millet Biodiversity and seed systems study
P Satish Kumar	India	PhD	Marker-assisted back cross transfer of QTLs for terminal drought tolerance between elite pearl millet maintainer lines
B Padmaja	India	PhD	Identifying effective cropping systems for carbon sequestration and their effect on soil organic matter in semi-arid tropics
B Pushpavathi	India	PhD	Variability of *Sclerospora graminicola*

Names	Country	Degree	Topic
D Prabhakar Reddy	India	PhD	Introgression of pod borer resistance in to pigeonpea (*Cajanus cajan*) using incompatible wild relatives
D Ramgopal	India	PhD	Studies on phenotypic and molecular characterization and evaluation in *Cicer* wild species and their interspecific populations
D Guruva reddy	India	MSc	Research on validation of available IPM components against groundnut pest complex in Andhra Pradesh
B Santha	India	PhD	Tissue culture and genetic transformation of dryland cereals with emphasis on pearl millet
G Sujana	India	PhD	Studies on mechanisms of resistance to pod borer in wild relatives of pigeonpea (*Cajanus cajan* (L))
J Sailasree	India	PhD	Microbiological and molecular characterization of microorganisms for the management of *Helicoverpa armigera*
SV Siva Gopala Swamy	India	PhD	Pigeonpea transgenics for resistance to *Helicoverpa armigera*
V Girija Shankar	India	PhD	Bioinformation of sorghum explants using Bt and other gene constructs
Dev Vart	India	PhD	Genetics of cytoplasmic - nuclear male sterility and molecular markers of their restorer genes in pearl millet
Y Venkanna	India	MSc	Bioefficacy of certain new insecticides against pest complex of groundnut
P Varalakshmi	India	PhD	Construction of integrated genetic maps in pearl millet
Joined during 2003			
A Ramakrishna Babu	India	PhD	Evaluation of transgenic chickpea for resistance to pod borer *Helicoverpa armigera* Hubner
Mohan Prakash Bhagwat	India	PhD	Inhibition of Helicoverpa gut proteases by trypsin inhibitors from wild relatives of pigeonpea and chickpea
Georgina Chauke	Zimbabwe	BSc	Crop Production and Horticulture
Jonathan Chifamba	Zimbabwe	BSc	Land and Water Resource Management
Kupe Chiedza	Zimbabwe	BSc	Crop Science
Luu Minh Cuc	Vietnam	PhD	Molecular tagging of a resistance gene to groundnut bacterial wilt/late leaf spot/rust pot rots
M Jyostna Devi	India	PhD	Identification of mechanisms for drought response in groundnut (*Arachis hypogaea* L.)
Oscar Dlodlo	Zimbabwe	BSc	Crop Production and Horticulture
Santhosh P Deshpande	India	PhD	QTL analysis for shoot fly resistance in sorghum (*Sorghum bicolor* L Monech.)
Jiang Huifang	China	PhD	Genetic diversity and molecular markers of resistance to bacterial wilt in groundnut
Robby Jaya	Zimbabwe	BSc	Biochemistry
T Jyothi	India	PhD	SSR-marker assisted backcross introgression of QTL's for host plant resistance to Shoot fly in sorghum
Ch Ashok Kumar	India	MSc	Improved early maturity in groundnut
Albert Murehwa	Zimbabwe	BSc	Biochemistry
Lindani Mkandla	Zimbabwe	BSc	Crop Science
M Pooja Bhatnagar Mathur	India	PhD	Studies on the development of abiotic stress tolerance in groundnut *Arachis hypogaea* by genetic transformation

Names	Country	Degree	Topic
R Chandra Mouli	India	MSc	Assessing opportunities for marker-assisted backcrossing of stay-green QTLs from sorghum donor E36-1
Douglas Moyo	Zimbabwe	BSc	Biochemistry
Albert Nikiema	Burkina Faso	PhD	Fruticulture, Sahelian Eco-Farm
S Nedumaran	India	PhD	Assessing the impacts of policy and technological interventions in micro-watersheds - A bio-economic modeling approach
Scott Ryan Nelson	USA	PhD	Emerging partnerships in biotechnology—the remaking of Indian agriculture in the twenty-first century
V Lakshmi Narayanamma	India	PhD	Genetics of resistance to pod borer *Helicoverpa armigera* in chickpea
D Srinivasa Reddy	India	PhD	Gene expression in groundnut transgenics under abiotic stress conditions
P Ramu	India	MSc	Marker assisted back crossing of stay green QTL into elite sorghum lines
P Vasudeva Reddy	India	MSc	Effect of eco-friendly insecticides on *Helicoverpa armigera* (Hubner) and its natural enemies in chickpea ecosystem
Kaisu-Leena Rajala	Finland	MSc	The adjustment of 10 corn varieties from desert American Indians to the Sahelian conditions
K Sireesha	India	PhD	Determination of efficacy of different HaNPV strains and standardization of production procedures
S Chander Rao	India	PhD	Studies on transgenic resistance to viral diseases in groundnut
G Sreelatha	India	PhD	Genetic transformation for pod borer resistance through Agrobacterium in pigeonpea [*Cajanus cajan* (L.)]
M Swathi Sree	India	PhD	Analysis of biochemical and physiological response of legumes to drought
N Sridevi	India	MSc	Marker-assisted backcrossing of a stover quality QTL in pearl millet
Makanyadza Takaendesa	Zimbabwe	BSc	Soil Science

Workshops, Conferences, Meetings during 2003

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
Chickpea Scientists' Meeting, 16-17 January	ICRISAT, Patancheru	40	Australia, Bangladesh, Canada, Ethiopia, India, and Nepal	ICRISAT
ICRISAT Watershed Team Building Workshop, 28-29 January	ICRISAT-Patancheru	26	India and ICRISAT scientists	ICRISAT
Roundtable discussion on the establishment of a Virtual University for the semi-arid tropics, 27 February	ICRISAT-Patancheru	35	India, Sri Lanka, Thailand	ICRISAT and MSSRF
A workshop on *Heterosis in Guinea-race Sorghums,* 10-12 March	ICRISAT, Mali	30	IER (Mali), INERA (Burkina Faso), INRAN (Niger), CIRAD (France), University of Hohenheim (Germany), Cornell University (USA), and University of Mali	ICRISAT and IER
The International Biotechnology Colloquium – Bridging the Technology Divide: Agri-science alliances and the new architecture of innovation, 17-20 March.	ICRISAT, Patancheru	100	Ten CGIAR centers, Donors, ARIs, NGOs, NARS, Private Sector participants from North and South America, Europe, Asia (20 participating countries)	ICRISAT, ILRI, ISNAR, CIAT, Applied Biosystems, Rockefeller Foundation, Sygenta, Sun Micro Systems and Avestha Gengraine
Launching workshop on *Improved Livelihoods in the Sahel through the Development and Implementation of Household level Bio-Economic Decision Support Systems* funded by the Directorate General for International Cooperation (DGIC), the Government of Belgium, 18-21 March	ICRISAT, Niamey	41	Niger, Belgium, Burkina Faso, Germany, Zimbabwe, Côte d'Ivoire	ICRISAT, INRAN, UCL, ACMAD, AGRHYMET, Project Intrants FAO, LRI, IMOORIBEN, CRESA and AQUADEV
Workshop on *Village Level Studies,* 27-28 March	ICRISAT, Patancheru			ICRISAT
Project workshop on *Participatory watershed management for reducing poverty and land degradation in the semi-arid tropics,* 7-9 April	Bangkok, Thailand	31	China, India, Thailand, Vietnam, FAO, ADB	ADB and ICRISAT
ILRI Workshop on *Enhancing livelihoods of poor livestock keepers through increasing use of fodder in Andhra Pradesh, Karnataka, Maharashtra and Orissa,* 14-16 April	ICRISAT, Patancheru	40	India-NGOs, NDDB, IGFRI, ICRISAT, IWMI Nigeria-IITA Ethiopia-ILRI	DFID and ILRI



Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
A media workshop called *Jal Swaraj: Facing the water emergency,* 16 April.	Chennai		India	MSSRF and ICRISAT
CPHP partners Post harvest innovation, 15-16 April	Parwanoo, Himachal Pradesh, India		DFID, CPHP, SA	CPHP, SA and ICRISAT
Workshop on *Fertilizer micro-dosing for small farmer prosperity in the Sahel,* 15-17 April	Sadoré, Niger	30	Burkina Faso, Mali and Niger	ICRISAT and USAID
Workshop on *Combating land degradation and increasing productivity in Madhya Pradesh and eastern Rajasthan,* 29-30 April.	ICRISAT-Patancheru	35	India and ICRISAT Scientists	TATA, ICRISAT and ICAR
Workshop on *Building Effective and Synergistic GT1-GT2 Linkages: Using Product Centric Teams and Multidisciplinary Project Management,* 12-13 May	ICRISAT, Patancheru	40	ICRISAT	ICRISAT
Workshop on *Identifying systems for carbon sequestration and increased productivity in the semi-arid tropical environments,* 13-14 May	ICRISAT, Patancheru	19	India and ICRISAT Scientists	NATP (ICAR) and ICRISAT
Regional Launching workshop on *Improved Livelihoods in the Sahel through the Development and Implementation of Household level Bie-Economic Decision Support* Systems funded by the DGIC, the Government of Belgium, 18-20 May	Dantiandou	10	Niger	ICRISAT, MOORIBEN and Project Intrants FAO
Spatial Analysis using ASReML, 4-6 June	ICRISAT, Patancheru	20	ICRISAT	ICRISAT
Workshop on Logical Framework, 9-11 June	ICRISAT, Patancheru	45	ICRISAT Scientists	ICRISAT
Launching workshop on *Impacts of Climatic Changes in the Fakara Area,* 9 and 16 June	AGRHYMET and ICRISAT (TVC)	10	Niger	ICRISAT, ILRI, INRAN, MOORIBEN and AGRHYMET
Regional Launching workshop on *Improved Livelihoods in the Sahel through the Development and Implementation of Household level Bio-Economic Decision Support Systems* funded by the DGIC, the Government of Belgium, 24-25 June	Zinder	8	Niger	ICRISAT, AQUADEV and INRAN


Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
Regional Launching workshop on *Improved Livelihoods in the Sahel through the Development and Implementation of Household level Bio-Economic Decision Support Systems* funded by the DGIC, the Government of Belgium, 27-28 June	Maradi	12	Niger	ICRISAT, INRAN, Project Intrants FAO and AQUADEV
Media workshop on water and sanitation 30 June-2 July	ICRISAT Patancheru	35	India, Sri Lanka, Bangladesh and Nepal	WSSCC of UN, FEJI, IDFC and ICRISAT
Expert meeting on Alternative uses of sorghum and pearl millet in Asia, 1-4 July	ICRISAT, Patancheru	60	China, Kenya, India, Indonesia, Pakistan, Thailand, and USA	Common Fund for Commodities (CFC) and Effem India Private Ltd.
Review and Planning Workshop, ADB funded project: Rapid Crop Improvement for Poor Farmers in SAT, 14-18 July	ICRISAT, Patancheru	40	ADB Bangladesh (BARI) Brazil China (CAAS/SRI) India (NARS) Pakistan (PARC) Vietnam (LRDC/OPI) Kenya	Asian Development Bank (ADB) and ICRISAT
One day Brainstorming session on *Molecular Breeding Community of Practice with Private Sector Seed Companies,*15 July	ICRISAT	50	Private/Public Sector Seed companies, NARS, Venture Capitalists, and from several Asian countries	ICRISAT
Workshop on *Social analysis in assessing gender-related impacts of NRM options focusing on build-up of social capital*, 17-18 July	ICRISAT, Patancheru	20	ICRISAT, FAO, RAP, ODI, Disha Foundation, UNDP, AP Mahila Samatha, HCU	FAO-RAP, Bangkok and ICRISAT
Training workshop on Participatory Watershed Management, 1-20 September		10	China, India, Thailand, Vietnam and ICRISAT Scientists	ADB and ICRISAT
Planning Workshop on *Water scarcity and food security in tropical rain-fed water scarcity systems for multi-level assessment of existing conditions, response options and future potentials*, 11-12 September.	ICRISAT, Patancheru	26	India, Austria, Mexico, Syria, Sri Lanka, South Africa, West Africa, and ICRISAT/ IWMI Scientists	IWMI and ICRISAT
Final project workshop of the BMZ-funded SADC/ICRISAT Groundnut Improvement Project, 15-16 September	Lilongwe, Malawi	20	Malawi, Mozambique, Zambia, and Zimbabwe	ICRISAT, Patancheru
Workshop on *Exploring Marketing Opportunities Through a Research, Industry, and Uses Coalition: Sorghum Poultry Feed,* 7 October	ICRISAT, Patancheru	19	India	DFID

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
Workshop on *Genetic and climate analysis for more efficient breeding of drought resistant peanuts,* 15 October	ICRISAT, Patancheru	32	India	ACIAR, ICRISAT and ICAR
Workshop on *Selection for peanut varieties with low aflatoxin risk,* 16 October	ICRISAT, Patancheru	20	India	ACIAR, ICRISAT and ICAR
A workshop on the logframe development for the collaborative project between the Japan International Research Center for Agricultural Sciences (JIRCAS) and ICRISAT, 30 October	Niamey, Niger	14		
Workshop on *Agricultural Diversification and Vertical ntegration Iin South Asia,* 5-6 November	New Delhi, India	80	South Asian countries, donor organizations, NGOs, private sector and advanced research institutions	FICCI, ICRISAT and IFPRI
Seventh CLAN Steering Committee Meeting, 10-12 November	ICRISAT, Patancheru	45	Bangladesh, China, India, Indonesia, Iran, Myanmar, Nepal, Philippines, Sri Lanka,Thailand, and Vietnam	APAARI, AVRDC, ICARDA and ICRISAT
SWMnet's (Soil and Water Management Research Network) first stakeholder workshop, 10-12 November	Nairobi, Kenya	40		
DFID-ICRISAT International meeting on Combating Biotic Stresses in Pigeonpea, 13-14 November	ICRISAT, Patancheru	38	China, India, Myanmar, Nepal, Sri Lanka, UK, USA,	DFID and ICRISAT
Review CPHP, 26-27 November	ICRISAT		DFID CPHP partners	CPHP, SA, and ICRISAT
Final review meeting on stylosanthes for agricultural systems, 26-28 November	Dharwad, India	30	CISRO, Australia, IGFPRI, ANGARU, ILRI, ICRISAT, TNAU, UAS-Dharwad	ACIAR, IGFRI and ICRISAT
International Symposium for Sustainable Dryland Agriculture Systems (ISSDAS), 2-5 December	Palaisdes Congrès, Niamey	92	Botswana, Burkina Faso, Canada, Finland, Germany, India, Israel, Kenya, UN Agency, Mali, Malawi, Namibia, Niger, Norway, Senegal, South Africa, Sudan, Tanzania, United Kingdom, Zimbabwe	ICRISAT, IPALAC, INRAN, Gov. of Finland and IDRC
ICRISAT-Private Sector Ad-hoc Committee Meeting, 18 December	ICRISAT-Patancheru	10	India	ICRISAT-PS Hybrid Parents Research Consortia


DE FORMATION SUR L'EVALUATION DE L'IMPACT
NOLOGIES AGRICOLES EN AFRIQUE DE L'OUEST
IAKO - MALI
12 - 16 JUILLET 2004

ICRISAT in

THE HINDU, Wednesday, August 4, 2004 3 HYDERABAD

Chief Minister asks ICRISAT to help farmers

8 THE HINDU, Monday, July 21, 20

SUCCESSFUL USE OF IT FOR TELEM

Philippines research for tie-up with ICR

By Y. Mallikarjun

HYDERABAD, JULY 20. Taking a cue from India's successful use of information technology for telemedicine, the Philippines apex agricultural research body has decided to adopt the technology in an innovative way -- to provide experts' advice from Manila to farmers spread across 7,000 islands of the nation on a variety of crop management aspects, which include tackling pests and

"I have already decided to use this concept for agriculture. We will call it tele-agriculture and invite your experts to help us set it up under the aegis of Philippines Open Academy", he said. Stating that dissemination of farmer-related information through ICT would be given thrust under the proposed project, he said that apart from advising on how to tackle pests and diseases, experts sitting in Manila could advise farmers in remote islands on a range of issues like increasing crop production and reducing the costs.

He said that 70 per cent of the people in his ...

THE HINDU, Sunday, August 24, 2003 5

ICRISAT is ... stay

By Our Special Cor...

HYDERABAD, AUG. 23. ... Director-General, Int... Crops Research Institute ... Semi-Arid Tropics, ... made it clear that the ... was here to stay in India and ... tinue its work in Asia.

At the same time it would ... tinue and strengthen its wor... sub-Saharan Africa. His ... tion, virtually setting at rest spe... ulation over its shifting ... sub-Saharan Africa, came after ... the External Management Re... view Panel (EMRP) gave ICRISAT a strong rating. "The Institute has endured trying times," said the Panel. This review complements the conclusion of another com... mittee, the External ... Review (EP...

'Sweet altern...

10 హైదరాబాద్

ఇక్రిశాట్ లో మూడురకాల హైబ్రీడ్ విత్తనాల అభివృద్ధి

आधुनिक तकनीक ... तक पहुंचाएं - ...

Société

Fin de l'atelier de consultation s...

Le point des re... matière de produ...

Les travaux de l'atelier de consultation initié par l'ICRISAT et l'INRAN, sous financement de la fondation MC Knight, ont pris fin vendredi 30 janvier dernier. Pendant 4 jours, les participants (venus d'Afrique, d'Europe, ... du Sud et du Nord) ont ...

THE HINDU, Saturday, July 5, 2003 5

Better marketing of sorghum, pearl millet stressed

By Our Staff Reporter

HYDERABAD, JULY 4. How can value be added to plebeian crops like sorghum and pearl millet so that farmers who grow them in the rainfed drylands of Asia get higher returns for their produce? This was the theme of a meeting of "experts" organised at ICRISAT near here in the first four days of this month. The main ideas, which emerged, were to market these crops better in niche areas and position them as better alternatives to existing options.

Even though sorghum and pearl millet were considered a "poor man's food", they had many dietary advantages over wheat and rice, which could be exploited in the health food market. Similarly, these crops were ideal for adoption in the poultry industry, for producing alcohol and bio-fuels and could also meet the needs of fodder, explained C.L.L. Gowda, scientist at ICRISAT. He added that one of the main obstacles identified ...

supply chain and lack of awareness among potential users.

For this, ICRISAT was gearing up for "policy advocacy" so that governments bring the same level of support to these crops as they do to wheat and rice, said the ICRISAT Director General, William D. Dar. He added that the meeting had identified gaps in research, which were needed to make such crops more market friendly.

A number of project ideas too had been listed and development opportunities identified, said A. Kuleshov of the Common Fund for Commodities (CFC). The CFC, which is a UN organisation and is mandated with helping developing countries integrate their commodities with the global market, has been a prime sponsor of this meeting. The meeting was attended by over 60 representatives of scientific and official agencies, seed companies, sugar mills, ... feed manufacturers, as well as farm...

The proceedings of th... would be published for wider dissemi... ideas and wider policy debates, informed Mr. Kuleshov.

Atelier de consultation sur les systèmes de production mil et sorgho en

L'amélioration des systèmes de productio... au centre des préoccupations

... atelier de consultation sur les systèmes de production mil et sorgho en Afrique de l'Ouest a débuté ses travaux hier, au Palais des Congrès de Niamey. Cet atelier qui dure 3 jours est co-organisé par l'ICRISAT et l'INRAN, grâce au financement de la fondation Mc Knight. Il vise entre autres, à susciter une meilleure compréhension entre la recherche agronomique, sécurité alimentaire et les ... nutritionnels, un échange ... méthodologie et d'approche ... organisations du secteur ... les participants procéderont ... examen critique de l'im... la sécurité alimentaire ...

... couragement des domaines potentiels de collaboration inter-institutionnelle.

La cérémonie d'ouverture de l'atelier était présidée par le ministre du Développement Agricole, M. Abari Mai Moussa, en présence du ministre des Ressources Animales, M. Koroné Maoudé, du directeur de la fondation Mc Knight, M. Binger, du représentant régional de l'ICRISAT au Niger, M. Bruno Gérard, du directeur de l'INRAN, le Dr Issaka Mamane, des représentants des institutions internationales, des ONG et projets et d'autres invités.

Avant d'ouvrir les travaux de l'atelier, M. Abari Mai Moussa s'est dit réjoui pour le choix du Niger en vue d'organiser cet atelier d'une grande importance en ce sens qu'il porte

sur la recherche et l'amélioration des systèmes de production du mil et du sorgho, deux principaux produits alimentaires au Niger et en Afrique de l'Ouest.

Pour le ministre du Développement Agricole, le choix du thème de cet atelier se révèle pertinent et vient à point nommé car le Sommet du CILSS de Nouakchott du 25 janvier dernier a fait de la question de la sécurité alimentaire l'une des préoccupations essentielles des pays du Sahel. Et pour les pays comme le Niger dont le rendement agricole reste toujours modeste, cet atelier constitue l'occasion de faire l'état des lieux sur les recherches et au besoin proposer des solutions.

M. Abari Mai Moussa a demandé aux participants d'appréhender tous les problèmes liés au secteur ...

n the News

MEDICINE
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ISAT
Inauguration du 1er sys
Pour une agriculture
Icrisat scouting
Page 14
ur les systèmes de production mil et sorgho en Afrique de l'Ouest
echerches et stratégies en
ction et sécurité alimentai
THE ECONOMIC TIMES HYDERABAD
FRIDAY 2 MAY 2003
TRADE/COMMODITIES
Icrisat agri-biz incubator launched
Our Hyderabad Bureau
THE FINANCIAL EXPRESS
ICRISAT's Six Inventions Await Entrepreneurs
Icrisat Develops New Insect Resistant
Icrisat, ITC Testing Ground On E-choupals
Icrisat Varsity Arm Identifies Growth Engines
Int'l research center springs back to life, thanks to Pinoy scientist
ICRISAT for private partne
By Our Special Correspondent
William Dar, Director-G ICRISAT, addressing a press conference in Hyderabad on Friday.

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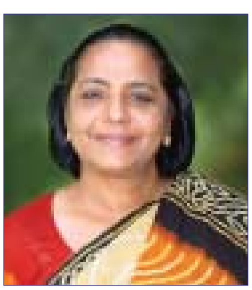

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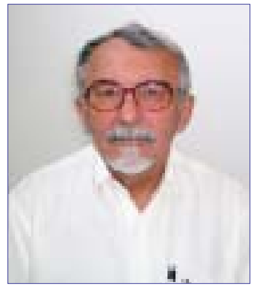

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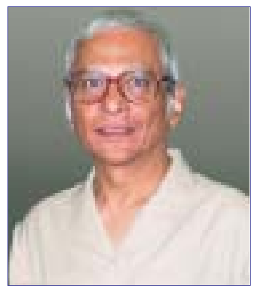

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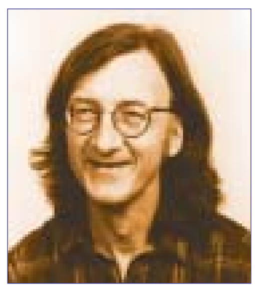

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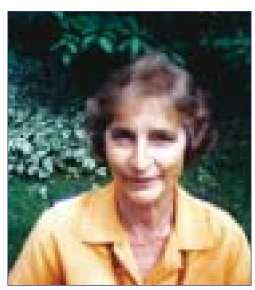

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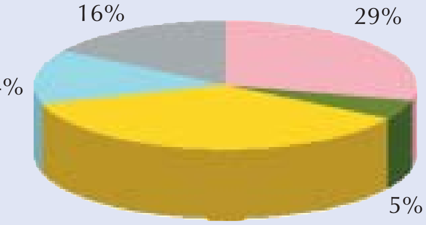
Financial Summary

Balance sheet

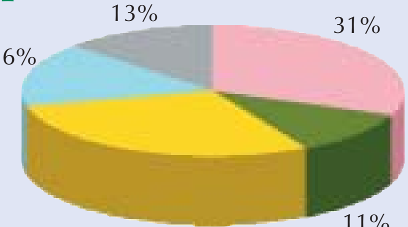
US$ thousands	2003	2002
Assets		
Cash and cash equivalents	5,389	3,992
Investments	10,283	8,670
Accounts receivable	6,484	5,778
Inventories	618	711
Prepaid expenses	313	328
Property and equipment - net	5,900	6,584
Other assets	6,927	5,188
Total Assets	**35,914**	**31,251**
Liabilities		
Accounts payable	4,317	3,120
Accruals and provisions	990	979
Payments in advance from donors	6,951	5,598
In-trust funds	140	117
Long-term liabilities	7,212	6,907
Total Liabilities	**19,610**	**16,721**
Net Assets		
Unrestricted		
Unappropriated	4,117	3,021
Appropriated	9,133	9,477
Permanently restricted	3,054	2,032
Total Net Assets	**16,304**	**14,530**
Total Liabilities and Net Assets	**35,914**	**31,251**

Expenditure by CGIAR Activity

2003



2002



Increasing productivity
Policy
Protecting the environment
Enhancing NARS
Saving biodiversity

Operating results and movements in net assets

(US$ '000)	2003	2002
Operating results		
Revenue	24,204	20,894
Expenditure	23,654	21,358
Change in net assets, operational	550	(464)
Extraordinary items	-	(3,538)
Change in net assets, operational (net)	**550**	**(4,002)**
Net assets - unrestricted		
Unappropriated		
Balance, beginning of the year	3,021	3,485
Operating (deficit)/surplus for the year	550	(4,002)
Improvements to physical facilities	(63)	(66)
Transfer from appropriated net assets	63	66
Early retirement scheme	-	3,538
Changes in accounting policies		
Special Purpose housing loan fund	281	-
Reclassification of loans granted from erstwhile housing loan fund	203	-
Additions to special purpose housing loan fund	62	-
Balance, end of the year	**4,117**	**3,021**
Appropriated		
Balance, beginning of the year	9,477	14,054
Changes in accounting policies		
Acquisition of Physical facilities	(63)	(66)
Housing Loans, net of interest	-	27
Special purpose housing fund	(281)	-
Early Retirement Scheme	-	(3,538)
Transfer to net assets - Permanently Restricted	-	(1,000)
Total Net Assets - Unrestricted	**9,133**	**9,477**
Net Assets - Permanently Restricted	**3,054**	**2,032**
Total Net Assets	**16,304**	**14,530**

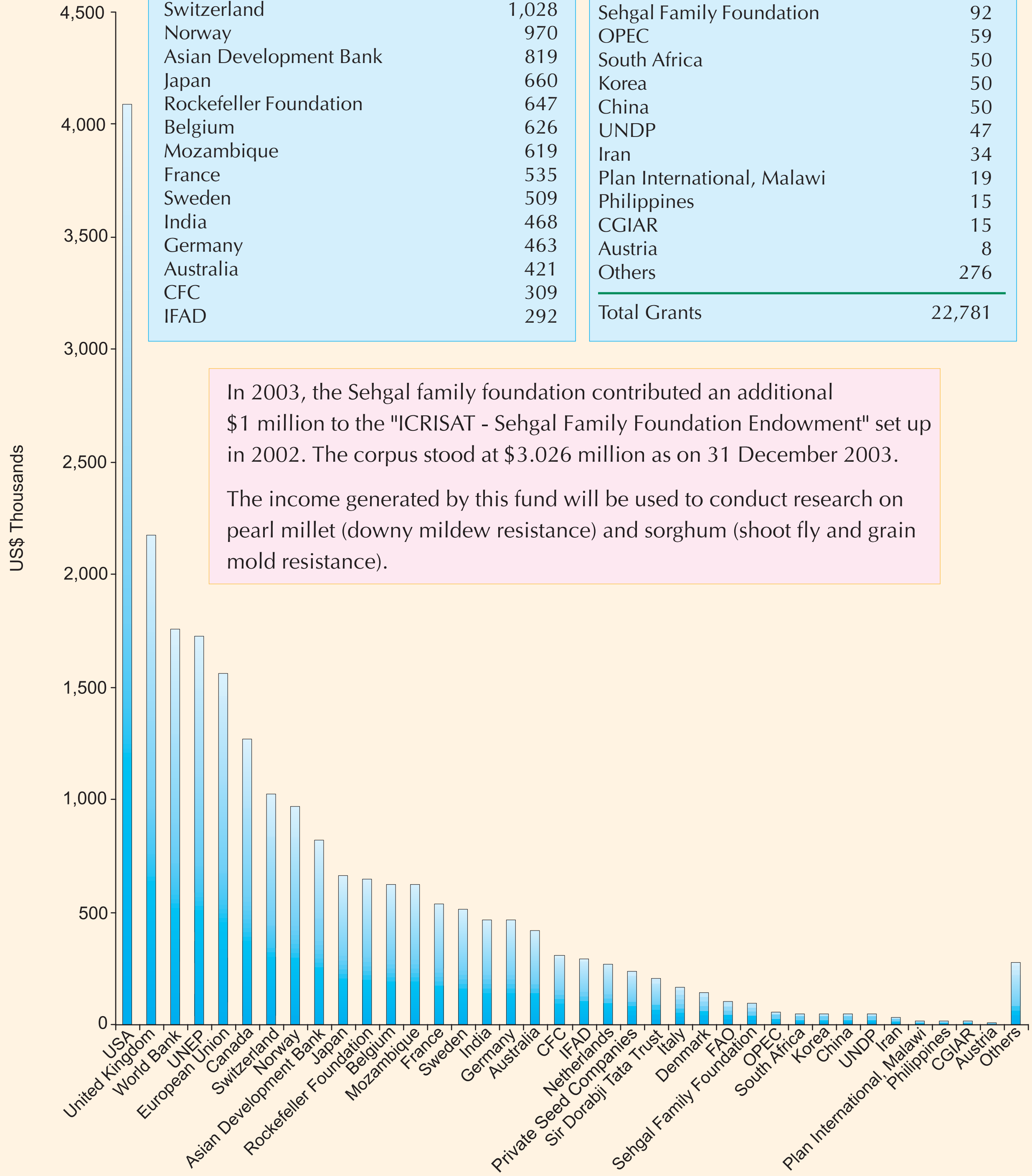
Grant income from donors for 2003

Donor	$ '000
USA	4,091
United Kingdom	2,174
World Bank	1,757
UNEP	1,724
European Union	1,561
Canada	1,271
Switzerland	1,028
Norway	970
Asian Development Bank	819
Japan	660
Rockefeller Foundation	647
Belgium	626
Mozambique	619
France	535
Sweden	509
India	468
Germany	463
Australia	421
CFC	309
IFAD	292

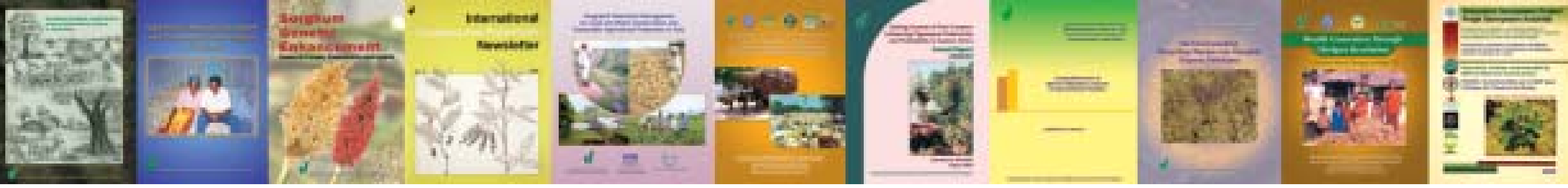
Donor	$ '000
Netherlands	270
Private Seed Companies	235
Sir Dorabji Tata Trust	206
Italy	168
Denmark	143
FAO	100
Sehgal Family Foundation	92
OPEC	59
South Africa	50
Korea	50
China	50
UNDP	47
Iran	34
Plan International, Malawi	19
Philippines	15
CGIAR	15
Austria	8
Others	276
Total Grants	22,781

In 2003, the Sehgal family foundation contributed an additional $1 million to the "ICRISAT - Sehgal Family Foundation Endowment" set up in 2002. The corpus stood at $3.026 million as on 31 December 2003.

The income generated by this fund will be used to conduct research on pearl millet (downy mildew resistance) and sorghum (shoot fly and grain mold resistance).



Publications



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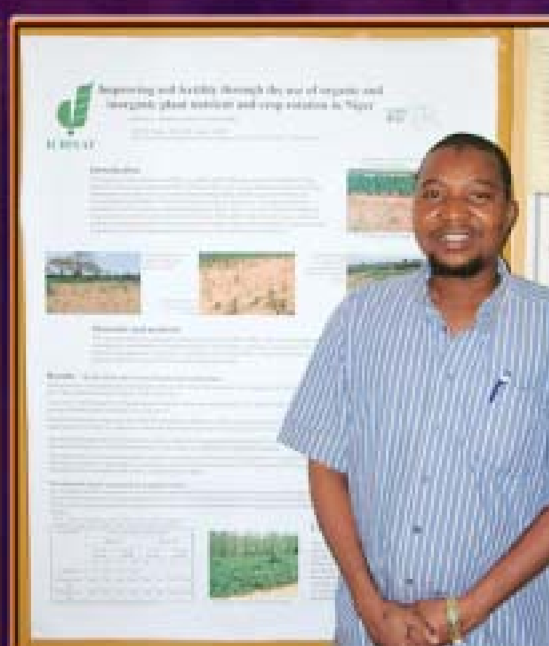

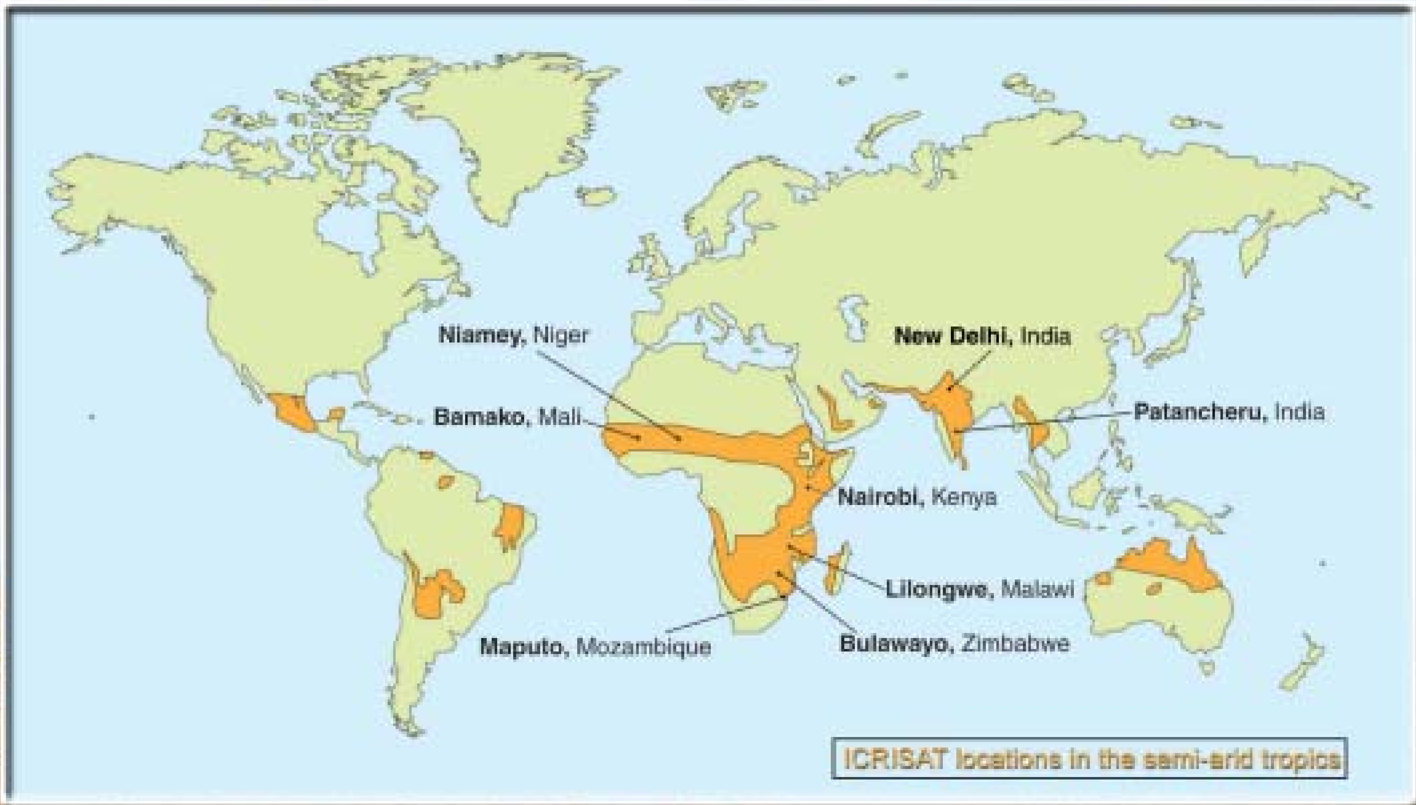

About ICRISAT

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political, international organization for science-based agricultural development. ICRISAT conducts research on sorghum, pearl millet, chickpea, pigeonpea and groundnut – crops that support the livelihoods of the poorest of the poor in the semi-arid tropics encompassing 48 countries. ICRISAT also shares information and knowledge through capacity building, publications and ICTs. Established in 1972, it is one of 15 Centers supported by the Consultative Group on International Agricultural Research (CGIAR).

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