ICRISAT
Annual Report 2001

Time Bomb Ticking at the Earth's Arid Edges

Hunkered in the 10 percent of vast, sand-blown Niger that is marginally arable, Amassagal's story is one of constant battle with the coming desert. The village was settled by nomadic Bella people about 80 years ago, after a brutal drought burned up millions of acres of grazing lands, killing thousands of people, camels and cattle.

In a tale repeated endlessly all over the scorched Sahel, men and women no older than 40 lament the drying of their world. Grasses were once waist high, they say. Trees once threw broken shade for the entire 3-mile walk to a main road. Back in the era of gazelles and wild pigs, children knew what meat was.

Farmer Zakara's ancient mother, Bibata Mahaman, hunched outside her hut, bolstering her spirits with stories of the famines she has outlived:

Kourou kaforoun, or "pull and throw away," because there were so many dead that the weak survivors could only toss the bodies in the bush.

Tamaba nyeze, or "a franc is better than a parent," because children were abandoned when families roamed the towns and deserts to beg or work.

Kanta kalage, or "let it grow back" because the starving were admonished to wait before eating the last tree leaves.

Sitting in the sparse shade of an acacia, Zakara nodded, smiling at the memories. He is a quiet man, as farmers often are.

Paul Salopek – Pulitzer Prize, 2001 - Chicago Tribune, March 25, 2001.

The CGIAR Desert Margins Program

"ICRISAT scientists are working to break the age-old link between drought and famine," said Mr. Ian Johnson, Vice President of the World Bank and CGIAR Chairman, at the Convention to Combat Desertification (CCD), held in Bonn, Germany, from 11-22 December 2000. He described the many activities borne of partnerships that are helping those living life on the edge.

The CGIAR's Desert Margins Program, convened by ICRISAT, is helping some of the poorest countries in the world (Botswana, Burkina Faso, Kenya, Mali, Namibia, Niger, Senegal, South Africa, and Zimbabwe) to implement science-based solutions to the problems of desertification. The Program engages these countries with eight CGIAR Centers, six advanced research organizations, and six major nongovernmental organizations.

Additional targeted support from development investors is critically needed to help rescue those clinging by a thread to the arid edges of the earth.

Cover: Aerial photos (150 m) showing benefits of fertilizer micro-dosing on millet in Kara Bedji village, southwest Niger (right) compared to traditional no-fertilizer practice in Banizoumbou (left). Fertilizer micro-dosing saved thousands of desert margin farmers from major crop losses during the drought of 2000 (see page 6). Photo: Prof. Dr. Andreas Bürkert, University of Kassel, Germany.

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Photo credits

In addition to the ICRISAT Photolab staff, special thanks are due to the following scientists and staff. Page 4: S. P. Wani, A. Ramakrishna. Page 5: A. Ramakrishna. Page 6: A. Bürkert (Univ. of Kassel, Germany), E. Sulzburger. Page 7: R. J. K. Myers, A. Ramakrishna. Page 8: K. B. Saxena. Page 9: Jagdish Kumar, S. C. Gupta. Page 10: G. V. Ranga Rao, R. V. Raman. Page 11: G. V. Ranga Rao. Page 12: E. M. McGaw. Page 13: M. Ferguson, H. C. Sharma. Page 14: R. Jones. Page 15: R. Jones Page 16: A. B. Obilana, R. J. K. Myers. Page 17: K. Anand Kumar, P. Subrahmanyam, S. Mohapatra, A. B. Obilana. Page 23: I. Akintayo. Pages 24-25: K. Anand Kumar. Page 35: R. Jones. Page 39: A. B. Obilana. Page 44: N. V. N. Chari.

Message from the Director General

Dear Friends,

ICRISAT works over a vast geographical area, a broad research agenda, and with a dizzying array of partners. Sometimes the complexity can seem overwhelming. To help tie it all together for you, we try to present it from a different perspective each year.

In 1998, we focused on our progress in building research-development linkages; in 1999, on partnerships; and in 2000, on the human face of our science. For 2001, we want to highlight an exciting development paradigm we call the Grey-to-Green Revolution.

Most are familiar with the Green Revolution of the 1960s/1970s. It had phenomenal impact. If it had not occurred, an extra billion people would be hungry today. New varieties of cereal crops were bred that gave high yield responses to irrigation and extra fertilizer. The global production of wheat and rice doubled, causing prices to decline by more than 70 percent in real terms since the 1970s.

Dr. Dar and Board Chair Martha B. Stone (left) meet the press

Yet with all its success, the Green Revolution may have instilled a premature sense of complacency in the world community. By saving the planet from the horrible consequences of mass starvation – and by enhancing productivity in the developed countries as well – it now seemed as if the world had plenty of food, so why worry? Agricultural research and development slipped down the world's priority list.

The idea that the food problem has been solved is a risky misperception. A quarter of the world's people and agricultural lands missed the Green Revolution party. About 840 million people, or 13 percent of the global population, are still food insecure. This food insecurity is concentrated in developing countries, with a regional breakdown led by South Asia in both numbers and proportions (48% food insecure), followed by sub-Saharan Africa (35%) and Latin America (17%).

Why this pain amidst plenty? The answer is poverty. The poor simply cannot afford to buy the food they need. Even subsistence farmers usually purchase significant portions of their annual food supply. People go hungry because they are without a productive enterprise – and for a large proportion of the poorest, the main enterprise available to them is agriculture, whether as farmers, laborers, family members, village entrepreneurs, or others.

And the consequences go beyond food. When there is no hope, the only option is to exploit the land to exhaustion, and then move on – leaving scars of despair etched on the land, as reminders of livelihoods lost.

So, post-Green Revolution, the CGIAR clearly recognized the need to retarget its goals towards using agriculture as a means for poverty reduction. To reduce poverty meant achieving greater social and gender equity through research on regions, ecosystems, and themes that would especially benefit the poorest of the poor. Many of these poor live in the 'semi-arid' or dryland tropics that are ICRISAT's focus.

In short, the new challenge was to turn the grey areas green. Mainly dependent on seasonal spurts of rainfall separated by long dry seasons, these areas are called grey not only because of the dry vegetation and dusty soils, but also because the poor lose hope as they slip further and further behind their better-endowed neighbors.

Turning the grey areas green – many have asked whether it is even possible. Harsh, unforgiving environments, yearly variation and risk, and low capital endowments of the poor all stack the odds against them.

But the American farmers in Kansas, and Australians in their wheat belt found ways to generate wealth from their dry zones. Why should the poor in the tropics not benefit from agricultural innovation? And what alternative does the world have anyway – to abandon these people, leaving them without hope, with no choice but to migrate,

swelling the ranks of the urban poor in distant cities, or in desperate flight to far-off lands?

But the good news is that the Grey-to-Green Revolution is well on its way. The poor of the dry tropics are learning how to grow their way out of poverty, using an ever-increasing number of technologies, knowledge, institutional partnerships, and support networks that national, regional, and international organizations in the public, private, and nongovernmental sectors have worked together to develop over recent decades. We are proud to have made significant contributions within these partnerships.

The key to success has been finding ways to adapt cropping systems to the natural variability of the environment, rather than attempting to homogenize the environment with massive inputs that are increasingly not viable either economically, or environmentally. Rather than eliminate diversity, we are helping farmers to turn it to their advantage.

Adapting the crop to the environment means farmers get more out of their own natural resource endowment. These low-cost productivity gains also position them well for an increasingly global economic market – a future that will engulf them soon enough, ready or not.

This is not to say that increases in inputs are not favorable or desirable for enhancing agricultural production. Crops cannot be produced without nutrients and water. Rather, we are helping find ways by which many of these inputs can be found on-farm or nearby, rather than purchased externally. By increasing system efficiency and reducing wastage, we and our partners are showing through smallholder-appropriate technologies that major gains are not only possible, but are being achieved in some of the harshest agricultural environments in the world: along the edge of the Sahel, in the rubble of the Deccan, across the plains of the Sudan, and in the shadow of the Kalahari.

In this report, we describe how:

- An integrated systems approach is making better use of precious water and transforming watershed landforms (small valleys) into wealth generators for the poor;
- Farmer-appropriate soil management practices are optimizing the use of scarce nutrients, delivering major productivity gains;
- Crop management and breeding innovations fit additional crops into the short 4-6 month growing season, boosting incomes while diversifying the enterprise to reduce risk;
- Integrated pest management techniques are stabilizing and increasing yields while reducing costs and the environmental hazards of pesticide use;
- Biotechnology is opening new vistas for capitalizing on the inherent adaptive capacities of crops;
- New networks, institutions, organizations, enterprises, and policies are emerging to more efficiently serve the needs of the rural poor; and
- Conscious focus on improving the technologies used by women is enabling them – and the children they care for – to gain extra benefits.

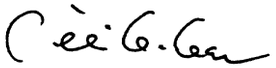
By providing the poor with multiple and synergistic options for major increases in productivity, we and our partners are enabling them to grow their way out of poverty. Making better use of their indigenous resources, they find their faith in the future restored, becoming self-reliant and confident enough to grow that better future for themselves.

It is a story of hope and progress, difficult but steady, working with the environment rather than against it. It is a story of hardy, determined rural folk using their wits to compensate for limitations of land and capital – working together in communities, enriching their livelihoods and those of their children.

We are honored to be able to share their success story with you. And we hope it will be gratifying to all those who have long stood with us as development investors, research partners, national teams, networks, and in so many other roles. We look forward to your continued support.

For those who are learning about us for the first time, we enthusiastically invite you to join hands with us in the Grey-to-Green Revolution. Together we will pledge our efforts and resources towards one of the most rewarding and satisfying challenges facing humanity today: the elimination of hunger, poverty, and environmental degradation in the dry areas of the developing world.

Yours in partnership,



William D. Dar
Director General

Water: the Essence that Greens the Grey

Without water, there is no agriculture – or life. Yet in the dry zones that form ICRISAT's mandate responsibility, drought occurs roughly two out of every five years. The scant rain often falls in short, intense bursts. Sadly, much of it (40-70%) is lost as runoff, evaporation, or deep drainage before it can contribute to crop production or village water reserves.

Precious lands lost from erosion

Improving the capture, storage, and use of this precious resource is crucial for turning the grey areas green. More than a quarter-century of ICRISAT research has proven that it ***can*** be done within the limited means of poor, smallscale farmers – and we are working closely with national, local, and community organizations to make this happen.

Solutions are at hand. Inexpensive, small earthen dams convert eroded gulleys into seasonal reservoirs that recharge depleted wells and make extended-season irrigation and cropping possible. Smallholder-appropriate landform treatments such as bunds, staggered trenches, silt traps, tied ridges, ridge/furrow formations, contour planting, grassed waterways, vegetative barriers, and dugout ponds all conserve water and drive it through the root zone where crops can use it – and into wells that quench the thirst of people and enable livestock to survive the scorching dry season.

Rock / earth dams convert gullies into reservoirs

Minimum or no-till relay cropping keeps the soil protected during flash rains, shading the soil to reduce evaporative losses and providing better growth conditions for soil fertility-enhancing organisms. Diversified and higher-value crops reduce risk, increase farmers' incomes, and provide an incentive for investing more in land improvement and intensification.

Contour bunds for productive water use and soil conservation

Silt traps prevent gulley formation

Gains are impressive. Long-term studies at ICRISAT's research station near Patancheru, India have quantified the potential of these techniques when applied in an integrated fashion:

- Evaporation and deep-drainage losses are slashed by more than half, from 45% to 19% of total rainfall;
- Runoff losses are cut by nearly half, from 25% to 14%;
- Soil losses from erosion decline by 75%, from 6.4 to 1.5 t ha^{-1};
- Sorghum yield increases by 350% to 4 t ha^{-1}; and
- Soybean yield increases by 150% to 2 t ha^{-1}, with similar percentage gains for other leguminous food crops like chickpea, pigeonpea, groundnut, and mungbean.

Scaling up, reaching out. Through generous supplementary assistance from the Dutch Government and the Asian Development Bank, practical applications of these exciting research findings are being rolled out jointly with national and local partners in community watersheds in Ethiopia (Ginchy), India (Kothapally in Andhra Pradesh and Lalatora and Solsinda in Madhya Pradesh States), northeastern Thailand, and northern Vietnam (Thanh Ha watershed in Hoa Binh Province).

Distant from each other in space, culture, and history, these four areas nonetheless share a common concern: their watersheds hold enormous potential, but face serious sustainability issues. In the Ethiopian Highlands, difficulty in tilling the heavy-clay Vertisols is causing rapid erosion and low crop productivity. In northern Vietnam, the rainfed sloping lands that cover about a third of the area are

degrading due to overpopulation and deforestation. In northeast Thailand, cassava planted at wide spacing exposes the soil to rapid erosion. In India, recurrent severe droughts keep rural villages mired in poverty.

People first. Since these watersheds are vital to the livelihoods of their inhabitants, a people-first approach is followed. Proposed interventions are discussed with and decided by farmer and community groups. Government and nongovernmental organizations (NGOs) enthusiastically team with ICRISAT to assist in providing the community interface.

During watershed walks with farmers in Ethiopia, for example farmers decided that a priority would be the design and construction of a main drainage system and a cutoff drain to reduce erosion. The system was designed with the help of the scientists, and constructed by community volunteers. It is functioning well and has convinced farmers to continue to work together to maintain it in perpetuity.

Community discussions for watershed development in Vietnam

Front line meets cutting edge. Not only farmers, but national research scientists benefit from these joint projects, learning modern scientific skills for sustainable land management. As part of the Asian Development Bank-sponsored project, scientists from Thailand, Vietnam, and India visited ICRISAT in 2000 to learn the new tools of geographical information systems, crop simulation, and remote sensing – key aids for characterizing and managing the spatial variability of watersheds. The workshop brought together the expertise of scientists from the National Remote Sensing Agency of India (Hyderabad), the University of Georgia (USA), and ICRISAT itself.

Calling all development investors! Managed in these ways, it is clear that integrated watershed management can jumpstart the Grey to Green Revolution, giving the poor the means to grow their way out of poverty. The governments of Ethiopia, India, Vietnam, and Thailand are confident that ICRISAT can help them create a more sustainable future for these fragile lands and the people that depend on them. And these experiences in turn will create benchmarks and prototypes that additional development investors can take advantage of to carry the Grey to Green watershed revolution to more and more needy areas. ICRISAT, as always, stands ready and eager to assist. ♦

Watersheds can generate prosperity if managed wisely

Water and nutrients: joined at the hip. Water and soil nutrients are inseparable in the Grey to Green Revolution. No matter how much water is available, its benefits are not realized if soil fertility is insufficient to support healthy plant growth.

Low soil fertility is a critical constraint across much of the dry tropics, especially in Africa. Since dry areas produce relatively less vegetation and their high temperatures promote oxidation, they are innately low in soil organic matter. Making things worse, these soils are often over-farmed because populations are rapidly increasing. Crop residues are fed to cattle or used for construction material rather than being returned to restore the fertility of the soil.

The conventional wisdom is that fertilizer application is too risky in low-rainfall environments. Our joint research with many partners has proven this to be an oversimplification. Soil nutrients in the proper amounts, balance, and timing actually reduce farmer risk because:

- they hasten crop maturity to avoid drought;
- they stimulate root growth so that plants find and use more of the rainwater that falls on the land; and
- they increase harvest index (grain filling) to enhance economic yield and grain quality.

The research and development challenge, then is to discover sustainable solutions that cash-strapped smallholders can readily adopt. ICRISAT is engaged in creative, participatory partnerships to do just that.

Micro-dosing for survival. Millet, the world's most drought-tolerant cereal crop, is the difference between survival and starvation for the peoples living on the edge of the Sahel (see inside front cover). But all is not well. According to the World Bank, Niger's millet yields have declined almost three percent annually since the mid-1980s, even though the area cultivated has doubled. This is a sure sign of over-farming the land and expanding into more and more marginal areas.

Because of the drought, farm communities in Chad, Burkina Faso, and large parts of Niger face serious food shortages in 2001, according to FAO. The situation is so serious that in early September 2000, Niger's President, Mahamadou Tandja, delayed a parliamentary meeting and asked that his ministers go to the mosque and pray for rain.

But there is hope on the horizon. An innovative micro-fertilizer technique tried by 5,000 farm households across 20 pilot sites in Niger is raising yields by 50 to 100% while buffering against the cruel vagaries of climate.

Affordable fertilizer micro-dosing turns the grey Sahel (above) green (below)

Farmers use a soda pop bottle cap to scoop about six grams of 15-15-15 NPK fertilizer and drop it into the planting hole with the seed, with hills sown at a density of about 5,000 per hectare. Since this operation is combined with planting, it incurs relatively little extra labor. The rates of application (4.5, 2.0, and 3.7 kg of elemental N, P, and K per hectare) are highly affordable – less than one-tenth of those commonly used on cereals in developed countries.

Soda bottle cap of fertilizer deposited with millet seed

The farmers who experimented with the bottle cap micro-dosage system are visibly better off. Phosphorus, natively deficient in Sahelian soils, is especially key in advancing crop maturity by a week or more, greatly reducing risk of terminal drought while contributing to the startling yield boost. This is the third consecutive year that the micro-fertilizer method generated these exciting results.

ICRISAT's partners in this initiative are the University of Hohenheim (Germany), the International Fertilizer Development Center (IFDC), the National Agricultural Research Institute of Niger (INRAN), the Food and Agriculture Organization of the United Nations (FAO), and a number of nongovernmental organizations.

FAO is working with villages to test a 'warrantage' system to help them afford these small amounts of fertilizer. The extra grain from bumper yields is stored as collateral on a loan, then sold during the annual shortage period to gain a higher price. The profits are used the following season to purchase more fertilizer.

"Using the micro-fertilizer system to fertilize our crops makes it possible for us to get the loan. Otherwise we wouldn't have enough grain to earn the cash we need to pay interest and make a profit," one farmer explained.

Soil Fertility: No Green Without It

High-tech models help farmers choose

Modern soil fertility research goes far beyond 'rate and date' agronomy. With the incorporation of newly developed modules for millet, pigeonpea, phosphorus, and manure, APSIM, a sophisticated computer simulation tool developed in partnership with Australia, is now in the field testing stage in both Africa and Asia, jointly with national research teams.

APSIM is a powerful tool for weighing tradeoffs among options through 'scenario analysis'. For example, it convinced one of the collaborating research teams to include extra weeding as an experimental treatment in its best-bet technologies for enhancing fertilizer response. It convinced another team to add low rates of nitrogen fertilizer as a trial option for sorghum.

The same model is being tested in Asia as well. In Tamil Nadu, India, for example, it helped convince farmers to try alternative sowing dates and more efficient water management for groundnut.

Participatory mother-baby trials in Southern Africa

Like mother, like child. The spectre of soil fertility decline also haunts the poor of Southern Africa. ICRISAT and its partners are working closely together in Botswana, Mozambique, Tanzania, Zimbabwe, and Malawi to meet this challenge through imaginative new approaches.

NARS/ICRISAT research teams are working with 300 farmers in Malawi in pilot villages representing the five major agroecosystems in the country. Researchers explain to farmers – most of whom are women – that the trials are organized like mothers and babies. The mother trials are larger and involve more factors; they are designed and managed by researchers to gather benchmark information for rigorous analysis. The baby trials, managed by farmers themselves, are geared to serve their immediate interests: the testing of just a few, practical, high-impact options that *they* are interested to try out. A typical pilot village may have one mother trial with 20 baby trials.

Both biological as well as socioeconomic data including profitability and cost:benefit ratios are collected. Most importantly, farmer perceptions and behavior are assessed using simple, clear ranking criteria collected in village interview sessions.

Farmers are excited about this creative new approach. As one described it, "Groundnuts doubled-up (intercropped) with pigeonpea is my new basal fertilizer, I grow them before my maize crop and I get a strong crop. I only have to apply a small amount of urea as a side dress."

Farm to school. A "Farmer Field School" is also part of the plan, implemented jointly with extension personnel and partner institutions in Zimbabwe. Participating farmers are encouraged to experiment with their ideas based on an understanding of underlying principles taught in the school. The private sector is also engaged, learning with farmers how both can benefit from increased access to input and output markets.

Summing up: the golden triangle. Soil-water-nutrient interactions are so fundamental to agriculture that scientists nowadays recite them as a single phrase. An integrated approach to their improved management is imperative, including the participation of farmers as the agents of change. This principle is the foundation of the Grey to Green Revolution. ♦

Soil-water-nutrient synergies create watersheds of plenty

Making Every Moment Count

The short 4-6 month growing season is a fleeting window of opportunity that can make or break the livelihoods of the poor in the dry tropics. Farmers struggle to extract every possible bit of green from the grey landscape while they have the chance. But a single low-yielding cereal crop is often all they can muster.

Through a range of ingenious technologies that enable them to fit more and higher-value crops into their systems, ICRISAT and partners are helping these farmers turn their grey world green. The benefits come through major jumps in total farm productivity, while greater system diversity helps cushion them against risk.

The key to success has been in adapting crops to more fully take advantage of the natural characteristics and variability of their environments – helping farmers get more from what they have, rather than by purchasing external inputs they can hardly afford.

Use it or lose it. The Vertisol soils that cover major areas of the dry tropics in Asia and Africa used to lay idle during most of the rainy period. Because they are heavy and sticky when wet, farmers could do little but wait until the rains nearly ceased to till them and plant.

ICRISAT is well known for helping develop a solution to this dilemma called broadbed-and-furrow (BBF) planting. The concave surface of the bed resists hardening while the furrows drain away excess moisture and enable farmer access. About 25,000 inexpensive BBF-makers (cattle-drawn) designed by our sister Center ILRI are already being used in the Ethiopian mid-altitude highlands, where staple cereals like wheat and teff can now be followed by a second crop of chickpea, lentil, or grasspea.

Broadbeds and furrows enable use of the full wet season

Legumes for health and wealth: pigeonpea. Few leguminous crops can tolerate heat and drought the way pigeonpea can. Nor can they match the crop's multiple-use and sustainability attributes, associated with its treelike growth habit. ICRISAT and partners have had striking success in Asia and Africa by fitting this pliable crop into a diverse range of cereal-dominated cropping systems.

They achieved major impact in west-central India (Maharashtra) by transforming the plant's architecture to a short, quick-maturing bushlike habit. The breakthrough variety P*ragati*, maturing in just four months compared with the typical six for this crop, moved into lands that were otherwise left idle in wait for a postrainy season crop of sorghum, chickpea or wheat. It delivers 93% higher yield and 30% higher net income than the previously-dominant variety (BDN 2).

Short early, bush-type pigeonpea

Spanning four countries (Pakistan, India, Nepal, and Bangladesh) and supporting 260 million poor, South Asia's Indo-Gangetic Plain stands at a critical juncture. Scientists are troubled by worrying signs of declining sustainability of the dominant rice-wheat cropping system. Breaking the continuous cereal cycle with a legume could make them more robust. Indian research organizations are testing the four-month pigeonpea line ICPL 88039 from ICRISAT that can fit into the rice slot but be harvested in time for the wheat sowing date. Trial farmers are extremely enthusiastic about the variety.

Chinese scientists from the Guangxi Academy of Agricultural Sciences concerned about rapid degradation of watershed slopes in highly populated areas of the south came to ICRISAT for help. Pigeonpea, a bushy plant that creates a protective soil cover while adding nitrogen and organic matter to the soil, spiked their interest. It has multiple uses including fodder for livestock and fuelwood (stems) to provide farmers an alternative to felling more trees.

Introducing new pigeonpea types to China

Making Every Moment Count

In Africa, Sudan's Agricultural Research Corporation came to ICRISAT with a plea for assistance. Prices of their staple faba bean were climbing beyond the reach of the poor. Faba requires cool temperatures to grow, but most of Sudan is hot - so they were forced to import to meet the demand.

They needed home-grown alternatives, and heat-loving pigeonpea immediately came to mind. Joint research identified early-maturing ICPL 90028, now named *Tayba*, with suitable grain quality to mimic the beloved faba. This new crop can now green the 50,000 hectares of grey land in the massive Gezira irrigation scheme south of Khartoum that lies mostly idle in the summer. Energized by this success, Sudan is asking ICRISAT's further help in finding pigeonpea varieties suited to rainfed conditions in the northeast of the country around Gedaref – a vast potential of over a million hectares.

Breeding chickpea for ever-earlier maturity

Chickpea. In contrast with heat-loving pigeonpea, chickpea is by nature a cool-season crop of temperate latitudes. A major impact of ICRISAT research has been to develop very short-duration, heat-tolerant varieties that could be grown further and further south into the dry tropics to exploit the ever-thinner slices of cool winter temperatures, maturing long after the rains cease by utilizing the last drops of stored soil moisture.

This new crop option is having a major impact on livelihoods in south India. Farmers, bereft of options and buried in debt from pesticide-intensive tobacco, cotton and chili pepper farming, were in such despair that hundreds were driven to suicide (Times of India, 5 October 2000). The new crop has restored hope and optimism. Andhra Pradesh has increased its chickpea production ninefold, adding an estimated $46 million to farm incomes – more than double ICRISAT's entire annual budget.

Hardy chickpea thrives on the soil moisture left by rice

These new tropical chickpea lines open a vast window of opportunity: they can be sown in fallow rice fields to make productive use of land that now stands idle. There are an estimated 14 million hectares of rainfed rice fallow across South Asia, mostly lying grey and barren after rice harvest – areas that can now be greened with a lush carpet of chickpea.

With ICRISAT's help this opportunity is already being exploited in Bangaladesh, where national researchers have introduced it into the impoverished northwestern Barind zone. The chickpea area in that zone soared from zero to 10,000 hectares in just a half dozen growing seasons, saving this ultra-poor country an estimated $3 million in imports annually. It is diversifying diets and generating new income opportunities for the extremely poor farmers of the area, most of whom are landless tenants.

Cereals. The staff of life, cereals are making equally impressive headway in greening the grey areas of the dry tropics. By breeding earlier-maturing varieties, ICRISAT and partner scientists have helped farmers avoid drought risk while gaining income more quickly and freeing precious weeks of growing time for other crops. The success stories are so many that only a few can be mentioned here.

Early-maturing sorghum has been a big hit in Ghana. ICSV 111 IN, or *Kapaala* as it is known locally, has many advantages – good eating and brewing quality, adaptability into an array of cropping systems, solid yield – but it is the variety's ability to escape drought by maturing early that has sold Ghanaian farmers.

A new millet variety, SOSAT C88 developed jointly with Burkina Faso, is spreading like wildfire across northern Nigeria and adjacent countries. Now grown by about 10,000 farmers, they cite its high yield, downy mildew resistance, excellent eating quality, and earliness as the key reasons they are – for the first time – willing to pay for millet seed, a crop many thought could never be improved.

SOSAT C88: *so satisfying in Nigeria*

Hybrids give another boost in pearl millet productivity and when combined with earliness, deliver a double-barreled benefit that farmers are embracing in northern India. An outcome of a research partnership that includes Haryana Agricultural University (India), ICRISAT, and the former INTSORMIL program at Kansas State University, the public-sector hybrid HHB 67 matures so early that farmers can also sow a postrainy-season mustard crop. The mustard provides vital cash to pay school fees and other needs. ♦

Knowledge Empowers Farmers Against Pests and Diseases

The Grey-to-Green strategy is all about enabling farmers to capitalize on their own resources to get more from their land than they ever thought possible. Knowledge is one of their most powerful, yet often overlooked resources.

In the absence of knowledge, fear and a sense of helplessness take over, particularly when disease epidemics and pest plagues seem to pop out of nowhere to threaten their livelihoods. But these scourges can often be prevented, controlled and/or damage mitigated through the use of local or shared knowledge, combined with cutting-edge research knowledge. ICRISAT is helping farmers find and share the knowledge they need to take back control over their destiny.

Voracious podborer on pigeonpea

Podborer blues. It's hard to believe, but a tiny insect the size of a thumbnail costs farmers over $1 billion worth of pigeonpea and chickpea production each year. The especially troublesome species *Helicoverpa armigera*, a close relative of the infamous cotton boll weevil, has become resistant to most chemical insecticides in India, leaving farmers in despair.

But a small village named Astha in Maharashtra State is setting a shining example of how people can change their world through knowledge and community action. The Hindi word 'astha' means 'faith' in English. But the community's faith in agricultural technology was sorely tested as the pesticides they came to depend on following the Green Revolution became costlier yet less effective as insects built up resistance.

Astha, at the end of its rope, called for help. Aided by assistance from IFAD, a joint team from ICAR, MAU, NCIPM, and ICRISAT worked with them to find practical ways they could implement integrated pest management (IPM) to combat attacks from the podborer and other plant pests and diseases without sacrificing yields – and often increasing them.

Sharing integrated pest management knowledge with farmers

Spraying can be reduced or eliminated with IPM

The result? A total turnaround. Astha has been a pesticide-free village for three years now. The farmers are firmly committed to the IPM approach, which they refer to in Hindi as *krishi sanjeevini* meaning "the farmers' revitalizing nectar". The Astha example that began with 10 locations in 1997 has since spread to over 1,000 farmers in 55 locations.

A knowledge-based approach can be equally effective against plant diseases. Smallholder farmers in Nepal had given up – they were abandoning chickpea cultivation because of repeated devastation from the Botrytis grey mold (BGM) disease. But ICRISAT and ICAR scientists visited Nepal regularly to share their knowledge about integrated control practices. Farmers applied them and reversed the tide, restoring high and reliable yields and rescuing this important crop diversification option. Believing after seeing on-farm trials, over 1000 Nepali farmers are now back into chickpea cultivation.

Integrated disease management is helping Nepal keep chickpea farming alive

A number of knowledge and technology components are leading the way to more rational and environmentally-safe pest and disease control for the future.

Bio-insecticides made from neem leaves and the nuclear polyhedrosis virus (NPV) – harmless to humans and animals – are being sprayed onto plants to kill *Helicoverpa* larvae. Farmers in Astha and other locations have been trained to culture the NPV and now produce it in the village itself.

Africa is not being left behind. Working in partnership, KARI, Kenyatta University, and ICRISAT field-tested the

first local isolate of NPV on pigeonpea at the Kiboko Research Station of KARI in Kenya this year. A student from the Kenyatta University visited ICRISAT for training in the production and use of NPV.

Bio-predators. Periodic releases of *Trichogramma*, an insect whose larva eat the eggs of *Helicoverpa*, have been very effective in Astha. And recent laboratory studies at ICRISAT demonstrated the effectiveness of micro-organisms (three fungi and three strains of bacteria) against *Helicoverpa*, killing over 70% of their larvae. Efforts are now on to find practical ways to implement this on a field scale.

Invented here. Sometimes the obvious is overlooked because it doesn't seem glamorous enough. Discussions with farmers in Andhra Pradesh, India revealed a simple but effective indigenous technique: by manual shaking of pigeonpea bushes, many podborer larvae can be dislodged and gathered to feed to chickens. Through knowledge-sharing efforts, the clever pigeonpea shake-down method has now spread to more than 100 villages in the state, and several thousand farmers are using it.

Manual shaking removes podborer

System thinking. The *Helicoverpa* problems in cotton and pigeonpea cannot be disentangled, because these crops grow in the same areas and the insect jumps from one to the other. A practical control strategy needs to deal with both crops. A joint project between NRI, ICAR, and ICRISAT recently introduced a best-bet control package in Andhra Pradesh. By adopting the package, farmers reduced chemical sprays by half while increasing their cotton yields.

Know thy enemy. The first step in empowering farmers to be able to act against disease plagues is to diagnose and understand the problem. Researchers from ICRISAT, NBPGR, and ANGRAU have just identified the cause of a mysterious disease that devastated the largest groundnut-growing area in the world in 2000 (the Anantapur and Kurnool Districts of Andhra Pradesh, India with 0.7 million hectares), causing $8 million in economic losses.

The team isolated the virus particles and studied their physical and chemical characteristics, their reaction to immunological tests, and their DNA sequence characteristics and found that the new disease, called Peanut Stem Necrosis Disease or PSND, is caused by the Tobacco Streak Virus (TSV). Knowing the virus immediately enabled them to hypothesize likely vectors and alternate hosts, and to suggest control measures that will be invaluable to farmers in the coming season. Through Andhra Pradesh Government support and in partnership with NBPGR and ANGRAU, a project has been launched to carry out further studies of PSND and how to control it.

A sad harvest in Anantapur in 2000

Likewise, cancer-causing aflatoxins are a danger and threat that can only be controlled through knowledge. Working jointly with the Scottish Crop Research Institute through DFID funding, specific monoclonal antibodies for aflatoxins were produced and a simple, inexpensive ELISA diagnostic test kit was developed. Already, two companies in India plus a public sector organization are putting the new tool to use to detect unsafe food lots. And ICRISAT recently helped foster global knowledge-sharing on aflatoxin by participating in an inter-institutional workshop in West Africa jointly with African scientists, US universities involved in the Peanut CRSP consortium, and CIRAD.

Diagnostics in the broad sense also includes systems to detect the presence and populations of insects – key early warning indicators of risk. Pearl millet stem borer causes substantial damage in Africa. Researchers from West African countries, IITA, Texas A&M University, University of Ghana, Sorghum/Millet CRSP, NRI, and ICRISAT worked for years to understand its behavior and synthesize the female pheromone. Pheromone monitoring traps are now in use in nine countries in the region.

Knowledge is Green. These examples demonstrate how knowledge frees farmers from fear and desperate decisions. ICRISAT, as an international organization with humanitarian motives, has proven that it can foster the kind of global knowledge-sharing that powers the Grey to Green Revolution.

Without the drought tolerance, nutrient use efficiency, pest and disease resistances, and many other traits that are built into the genetic fabric of plants adapted to the dry tropics, it would be difficult to envision a Grey to Green Revolution. Much progress has already been made using conventional breeding to accentuate these traits and add new ones. But many believe that what has been achieved so far will pale in comparison with the advances yet to come through the revolutionary new tools of biotechnology.

High throughput DNA marker facility

ICRISAT is betting heavily that biotech will play a major role in turning the grey areas green. During 2000, we made large investments in developing a new Applied Genomics Laboratory, especially for rapid-throughput, marker-assisted selection that will add new power to plant breeding. We are also investing in the bioinformatics computer support needed to analyze the huge volumes of genetic data that will soon be flowing from this lab. Disease/pest diagnostics and gene bank diversity analysis will also be revolutionized by these new tools.

As for all lines of investigation at ICRISAT, partnerships lie at the core of ICRISAT's strategy. For example, through our coordinatorship of the Cereal Legumes Asia Network (CLAN) we recently convened a successful proposal (now generously supported by the Asian Development Bank) to help Bangaladesh, China, India, Pakistan, and Vietnam apply biotechnology to accelerate the genetic improvement of groundnut, chickpea, and sorghum.

Biotech partnerships formed in Asia

Sorghum: breaking witchweed's spell. The use of markers is already well under way to solve important problems. Witchweed is the popular name for *Striga*, a parasitic plant that causes staggering annual losses in sorghum in Africa. Conventional plant breeding has made limited progress because of the complexity of the many genes involved and their interaction with the environment. Markers may be able to cut through this haze. Initial results from two German universities, Hohenheim and Tübingen, ICRISAT's partners in this initiative, confirm that molecular markers do appear to be associated with resistance. If these results are confirmed, marker-assisted selection could shave years off the breeding process while elevating the level of resistance in new varieties.

Witchweed (pink flowers) debilitates sorghum across Africa

Millet: taming downy mildew. Downy mildew disease is the worst scourge of pearl millet. Several times since the 1970s it nearly wiped out the crop in India. Scientists need a more powerful tool for strain identification and rapid response against the broad array of variants that have emerged.

ICRISAT and its partners (the John Innes Centre at Norwich, the Centre for Arid Zone Studies at the University of Wales at Bangor, and the Institute of Grassland and Environmental Research at Aberystwyth) found that markers could indeed help them to quickly and accurately identify genes that repel specific strains of downy mildew. Using the markers as tags, they are now pyramiding the genes together through crosses to provide broad-spectrum resistance in future millet varieties.

Studying pearl millet at the John Innes Centre, UK

DNA *extraction for chickpea drought project*

Chickpea drought resistance. Drought resistance has been an elusive dream for plant breeders. Stymied by the high cost and complex genotype-by-environment interactions that muddy the results from field trials, they are also turning to molecular methods in search of a new breakthrough.

Chickpea, sown at the end of the rainy season in the tropics, must chase the receding water table down the soil profile by extending its roots deeper and deeper. Breeding for exceptional deep-rooting would be much easier if molecular markers linked to the trait could be identified. Rather than digging up thousands of plants to measure their root systems, a costly and impractical method, finding markers in the lab could pinpoint the plants most likely to contain the desired genes.

But first, the map had to be created, and like groundnut (see below), this crop didn't seem to want to cooperate using the usual marker technology. A specific sequence tagged microsatellite site (STMS) marker system was finally developed in 1995 by Guenter Kahl's team at the Johann Wolfgang Goethe University in Germany, in collaboration with ICRISAT's sister center ICARDA.

Enabled by this breakthrough, Washington State University and ICRISAT then teamed up to use the STMS system to create the world's first molecular marker map for chickpea. So far, the map contains about 100 markers and has been used to locate 12 genes that govern important traits.

With the map in place, scientists are naturally eager to put it to use. ICRISAT and the University of Saskatchewan in Canada are joining hands to search for deep-rooting markers. This will take years to achieve, but the impact could be spectacular if it succeeds.

Groundnut: starting from ground zero. Groundnut, because of its unusually narrow genetic base, has also proven to be a hard nut to crack. So ICRISAT, in collaboration with the University of Georgia decided to target a different class of markers known as microsatellites – also known as simple sequence repeats (SSRs). An ICRISAT geneticist joined scientists at the University of Georgia under a USAID Linkage Grant designed to foster collaboration between US advanced research institutes and the international agricultural research centers. Together, the scientists were able to develop two genomic libraries of groundnut, each consisting of 27,000 clones.

Building a genomic library of groundnut with the University of Georgia

ICRISAT will apply the technique to assess the diverse array of both cultivated and wild germplasm in its genebank, the objective is to determine which primers are most effective in revealing differences among germplasm lines. Those primers will be the most valuable for developing the long-awaited molecular map of this important crop.

Pigeonpea: new tricks against an old adversary. ICRISAT's work with pigeonpea has focused on transgenics – injecting new genes from other species or organisms – instead of molecular markers. Because pigeonpea is particularly susceptible to insects, especially podborers (*Helicoverpa armigera*), the objective has been to introduce the bacterial Bt gene. If is toxic to podborer larvae, but harmless to humans and other organisms.

Transgenic plants are created by infecting the cultures with binary plasmids carrying the genes of interest. Molecular markers associated with the genes can then be detected to confirm gene presence. The transformed plants of pigeonpea are now being characterized in preparation for testing their efficacy against the podborer.

Bt endotoxin in artificial diet (right) kills podborer (untreated on left)

Similarly, an efficient protocol for sorghum transformation has been developed over the past several years through close partnership with and support from Australia's ACIAR and the University of Queensland. Research found that biolistic transformation (forcibly injecting microscopic DNA fragments coated onto a tungsten chip using a gun-like device) is more effective than vector transmission for this crop. Bt genes against sorghum stem borers obtained through collaboration with the University of Ottawa (Canada) have been inserted into the genomes of test plants, as confirmed by RFLP marker analysis. These plants are being multiplied for testing against the insect in one of ICRISAT's highly bio-safe glasshouses.

Numerous other imaginative efforts are being implemented in the biotechnology arena by ICRISAT and its partners. There is little doubt that they will provide a steady stream of Green news for years to come. ♦

New Partnerships: Working Together the Grey to Green Way

Without effective, efficient policies, institutions, and channels providing knowledge, technologies, inputs, and markets, agriculture cannot thrive. ICRISAT has been particularly active in helping developing countries innovate new institutional arrangements for more sustainable seed systems.

Does seed bring relief? Relief seed following war, drought, and other calamities can sometimes do as much harm as good, if implemented without due care for the quality and adaptation of the varieties introduced. ICRISAT is partnering with NARS, NGOs such as Catholic Relief Services, and the private sector to help development investors find better ways to help in times of need.

Understanding village seed systems in the Horn of Africa

Farmers prize diversity in germplasm

Solutions flow from an understanding of farmers' seed systems – both their strengths and their weaknesses. Take Bahr el Ghazal in southern Sudan, for example. Farmers' seed systems are based on social and barter networks within and between ethnic groups. Farmers know their sorghum (the country's staple cereal) and consciously maintain varietal diversity to reduce risk, provide a steady food supply, spread out labor peaks, and hedge against drought and other crises.

Seed Fairs reinforce community seed exchange of adapted germplasm

A seed voucher system pioneered by Catholic Relief Services in northern Uganda, Kenya, Tanzania, and most recently in southern Sudan, capitalizes on this farmer knowledge. In most communities, certain farmers are consistently able to produce a crop surplus, and are experts in seed selection and storage. Development investors provide the poor with vouchers that they can use to buy the seeds from these master farmers at seed fairs. The seed sellers then redeem the vouchers for cash from the issuing relief agency.

Since farmers know what constitutes good seed and where to get it, this approach puts them in control and rewards quality seed producers in the community. By reinforcing the natural strength of indigenous seed systems rather than encouraging dependency on external donations, the voucher system is a Grey-to-Green way to advance sustainable development.

Public-private partnership. Recognizing their inter-dependency, and alarmed by continuing declines in public sector budgets, the public and private sectors are now ardently searching for closer ties. Fourteen companies have collectively pledged more than $100,000 annually for

New Partnerships: Working Together the Grey to Green Way

Envisioning SAT Futures

A global series of brainstorming meetings were held during 2000 (in Kenya, Zimbabwe, Mali, and India) to envision future development scenarios for the dry tropics and how ICRISAT might most effectively contribute to them. The meetings engaged a wide range of stakeholders including ICRISAT staff, leaders from national and development programs, representatives from the private sector, nongovernmental organizations, and farmers' associations.

A wide range of trends and scenarios were discussed, including economic globalization, biotechnology, the information revolution, alternative income sources, crop and livestock investment tradeoffs, market liberalization, rural livelihoods, climate change, rising global water costs, labor markets/mobility, off-farm employment, feminization of agriculture, HIV/AIDS in Africa and Asia, land degradation, private/public partnerships, the future of national research and development systems, land rights/markets, and post-harvest issues.

Through this open consultation, ICRISAT is not only tapping a much deeper pool of wisdom and experience – we are ensuring that our partners share ownership of our emerging agenda. These meetings are a key input to a new ICRISAT strategic plan to be completed by late 2001.

the next five years to help support applied plant breeding research at ICRISAT. They have agreed that materials developed through this research will remain as international public goods freely available to all, as is required by ICRISAT's open, public, nonprofit constitution.

The confidence shown by the private sector in ICRISAT stems from a proven track record. To quote M. Prabhakar Rao, President of the Seedsmen Association, "Over the years the Indian farming community in general and the seed industry in particular have derived enormous benefit from ICRISAT's research. Most of the germplasm being used in our research and development programs has some of its origin in ICRISAT. ICRISAT has been very generous and liberal in providing germplasm and other forms of assistance in crop research." In Nizamabad District in Andhra Pradesh, for example, a recent survey reported that about 18,000 hectares spread over 80 villages are devoted to hybrid pearl millet seed production, with annual profits estimated at about $8 million.

ICRISAT's research with ICAR, the Indian Council for Agricultural Research, stimulated the take-off of the pearl millet seed industry in India in the 1980s and early '90s by developing resistant varieties that controlled the downy mildew fungus – a scourge that had farmers on the brink of abandoning the crop. An estimated 75% of pearl millet hybrids in India and 60-80% of private-sector sorghum hybrids are derived from ICRISAT parent lines.

New varieties spark a seed industry in Nizamabad

Pigeonpea research by ICRISAT and its partners led to the control of the devastating wilt fungus, shaved months off plant duration, and resulted in the world's first-ever hybrid of any food legume crop. And extra-early chickpea varieties have triggered a boom in Andhra Pradesh.

Village shops become seed suppliers in Southern Africa

Companies committed to the coalition include Advanta India, Ganga Kaveri Seeds, Hindustan Lever, J K Agri-Genetics, Kanchan Ganga Seed, Mahendra Hybrid Seeds Co., MAHYCO, Monsanto, New Nandi Seeds Corporation, Navbharat Seeds, Nuziveedu Seeds, Prabhat Agri Biotech, Proagro Seeds, Rasi Seeds, and Shriram Bioseed. The amount of investment is roughly equal for each to ensure equal participation and commitment.

"As wonderful as these investments are, they do not replace the enormously important role of international development assistance. Rather, they complement it," said Dr. William D. Dar, Director General of ICRISAT. Targeted investments by the private sector deliver quick impacts in poverty reduction and increased productivity. Public-sector investment ensures that long-term issues on matters such as environmental protection and poverty reduction remain at the heart of ICRISAT's agenda. Combined, they underpin a balanced research program for sustainable rural development.

By fostering indigenous agro-enterprise, ICRISAT is helping developing countries to stand on their own feet and stride more rapidly along the path from Grey to Green. ♦

Higher quality sorghum for diverse uses stimulates markets

Not many people realize that women produce 80% of sub-Saharan Africa's food, and 60% of Asia's. In many parts of Africa, children are increasingly dependent on women as more and more men migrate to cities or, worse, succumb to AIDS.

ICRISAT *places special focus on women*

ICRISAT emphasizes technologies that especially benefit women, both to promote greater social equity and to accelerate agricultural development. The focus on women also cultivates the future, because they are the primary caretakers of the children who will shape it.

Women lead. One could hardly find a better example than Maria Kaherero. Maria became interested in the farmer-participatory varietal selection approach that led to the highly successful 1989 release of *Okashana* 1 millet in Namibia. She took seed back to her own farm and grew it to naturally cross with local landraces, producing a genetic mixture from which she began selecting types for her own needs. The Maria Kaherero Composite remains a prime gene pool used widely across southern Africa to this day – proven by comparative tests run recently against breeders' own populations.

Women lead in Zimbabwe

Women drive. Enthusiastic women farmers in Zimbabwe are pushing ICRISAT researchers to accelerate the transfer of new water conservation and crop management techniques. Mrs. Moyo of Tsholotsho is one of the prime movers in participatory natural resource management trials that ICRISAT began in recent years. She is especially interested in modified tied ridging to reduce runoff losses, along with other treatments.

Women pioneer. Women farmers are also becoming pioneers as millet seed producers and marketers, helping to spread new varieties and overcome the sorghum and millet seed supply bottleneck in the country. ICRISAT is encouraging this effort together with Zimbabwe's national research system, a nongovernmental organization (Commutech), and a private seed company (SeedCo), through special project support provided by USAID.

Women innovate. ICRISAT scientists have found that women's associations such as the Ivuso in Kenya's drought-prone Makindu district are ready innovators – they experiment, share ideas, and put them to use. They are actively promoting improved varieties of pigeonpea after ICRISAT researchers showed them its potential as a food and cash crop.

Kenyan women test grain quality of new sorghums

Green pigeonpea seeds (harvested as a fresh vegetable before maturing) are a popular food in Kenya and beyond, and have become an important source of income for these women. Short-duration varieties like ICPL 87091, developed by KARI and ICRISAT, mature early. They also reach the market before the rest and fetch premium prices.

The women learned how to use the dry (mature) pigeonpea grain by milling it into the form of Indian dhal or split pea, during a visit to India facilitated by ICRISAT. They even carried back a traditional Indian grinding stone, or *chakki*, to copy for manufacture in Kenya.

Women care. It may seem an unlikely connection, but pigeonpea has helped the Ivusu women make a real difference in the lives of children orphaned by HIV/AIDS. They use it to help feed and fund an orphanage that they founded, the Children's Center in Makindu, Kenya.

The orphanage has to survive on its own resources, so the receipts from sales of pigeonpea, especially the high-value green peas, have been vital in keeping it afloat. Furthermore, the women report that pigeonpea consumption (both green and dhal) has markedly improved the children's health.

Women – children – future (millet beverage, Kenya)

It is clear that pigeonpea is more than just nutrition – in Makindu, it fuels hope. And hope is the fire that feeds the Grey to Green Revolution.

Women work. New innovations can provide employment opportunities as well as reduce the drudgery of women's work. Pigeonpea stalks are an ideal fuel, reducing the onerous task of firewood collection that largely falls to women. And the introduction of an improved groundnut production package developed by ICRISAT and ICAR in Maharashtra State not only generated 71% more income for farmers, but reduced the labor burden of women, because it made weeding and harvesting easier.

Women Make the Difference

Women work: weeding millet in Niger

It also helped generate more employment opportunities for them and gave them a greater role in decision-making. Similarly, in the Barind of Bangladesh where ICRISAT helped develop chickpea as a new cropping option in rice fallows, women found that they could earn money from the sale of the green young leaves of the plant – a high-value fresh vegetable that commands a good price because few others are available at that time.

Groundnut in sight. In Africa, groundnut is known as a women's crop. Grown around the household, it is a vital source of cash income and nutritious, high-protein food for the family. Children especially benefit from women's food and income-generating activities.

According to a recent UNICEF report, malnutrition kills more children in the world than infectious disease, war, or natural disaster. Malnutrition is implicated in more than 6 million deaths of children under age five each year and leaves millions of survivors stunted physically and intellectually.

Child blindness is a common result of severe malnutrition, partially due to vitamin A deficiency, which is strongly associated with insufficient fat in the diet. The human body requires fat to absorb vitamin A, such as the oil provided in groundnuts. By increasing groundnut production in ways that are affordable for the poor, the benefits to women spill directly over to help their children avoid malnutrition and its tragic consequences.

ICRISAT is working with partners to help Malawi increase groundnut production through the new higher-yielding variety CG 7, jointly developed with the Department of Agricultural Research and Technical Services. CG 7 has quickly spread to 10% of Malawi's groundnut area, contributing an estimated US$ 6.4 million annually in additional revenues. The nongovernmental organization World Vision International is helping accelerate CG 7's spread.

Women celebrate new groundnut varieties in Malawi

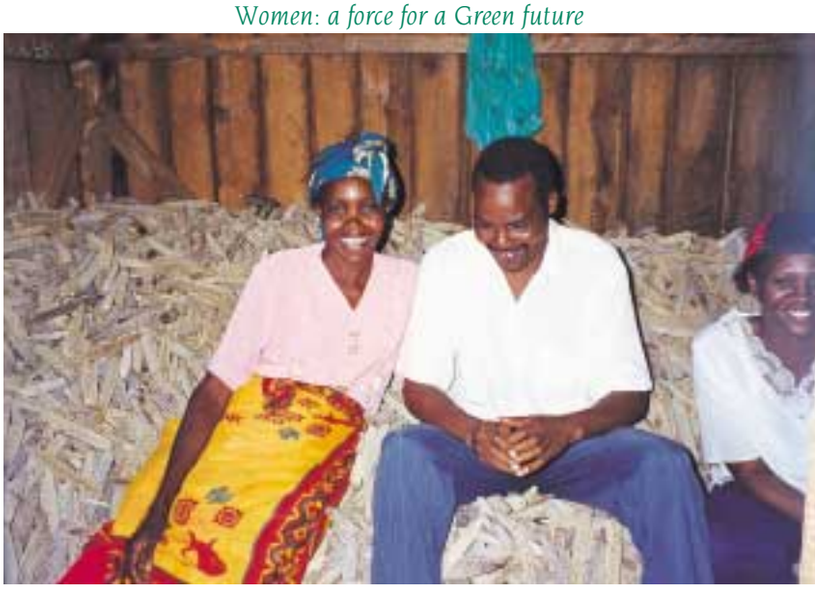
From East to West. Groundnut is also a women's crop on the other side of Africa. Malian women use the income from groundnut sales to feed their families and send their children to school.

Women in Mali: groundnut farmers

Through partnerships with the national research institute IER and ADAF-Galle, an NGO, ICRISAT, and women farmers are jointly testing improved disease-resistant groundnut varieties on-farm. The new varieties are consistently outyielding traditional ones by 50% and are resistant to foliar diseases, a major constraint in the region. They also mature earlier, a trait that helps them to escape drought at the end of the season.

A force for Green. By unleashing the power and ingenuity of women to turn the grey tropics green, ICRISAT and its partners are not only improving the livelihoods of today's generation. They are seeding the Grey to Green Revolution for decades to come. If the generous and steadfast commitments shown by development investors so far can be sustained, these women's children – and the planet they inhabit – have a much brighter future ahead. ♦

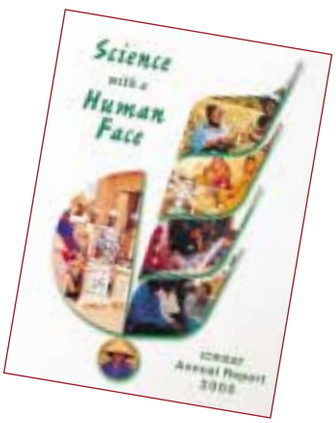
Women: a force for a Green future



Publications during 2000

Publications reflect the productivity and scientific quality of ICRISAT's *scientists and programs*

Scientific Journal Articles / Book Chapters / Conference Papers



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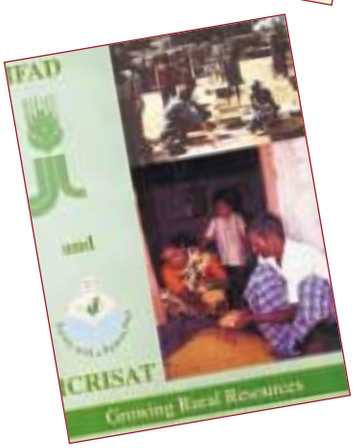

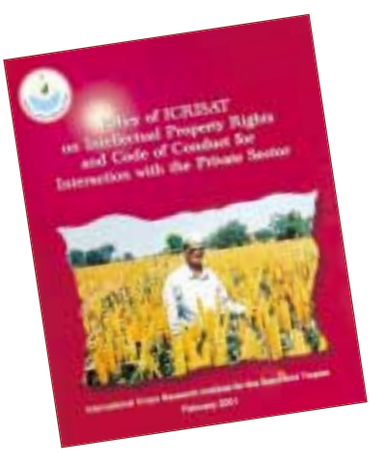

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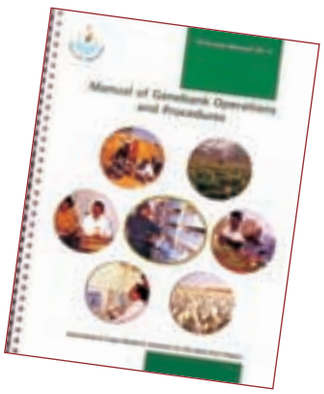

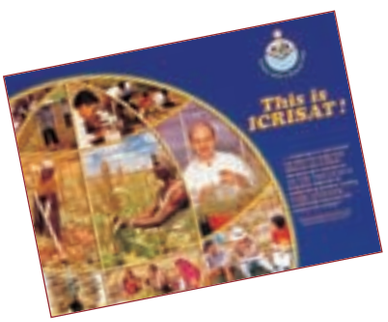

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Development Investor Partnerships: Targeted Projects

Development investors supplement the CGIAR's core support to carry out targeted projects on subjects of particular interest

Donor	Project	Collaborators
African Development Bank	Improving crop productivity in the semi-arid tropics of West and Central Africa with more efficient, environment friendly crop and pest management options	NARS of Niger, Mali, and Burkina Faso
Asian Development Bank	Legume-based technologies for rice and wheat production systems in south and southeast Asia	NARS of India, Nepal, Bangladesh, Pakistan, Sri Lanka, Vietnam
	Improving management of natural resources for sustainable rainfed agriculture	International Board for Soil Research and Management (IBSRAM); Central Research Institute for Dryland Agriculture (CRIDA), Jawaharlal Nehru Krishi Vishwa Vidyalaya, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Marathwada Agricultural University, BAIF Development Research Foundation, India; Field Crops Research Institute, Khon Kaen Field Crops Research Centre, Department of Land Development, Thailand; Ministry of Agriculture and Rural Development, Vietnam; Vietnam Agricultural Science Institute
Australia		
ACIAR	Increasing the effectiveness of research on agricultural resource management in the semi-arid tropics by combining cropping systems simulation with farming systems research	APSRU (Australia), ICAR-NARS (India), Kenya Agricultural Research Institute
ACIAR	Impact assessment and research evaluation activity in Thailand	Department of Agriculture, Thailand; Kasetsart University, Thailand; ACIAR, Australia
ACIAR	More efficient breeding of drought-resistant peanuts in India and Australia	ACIAR, Australia; ICAR, India; Queensland Department of Primary Industries, CSIRO, Australian National University, Peanut Company of Australia, Australia
ACIAR	Development and use of molecular genetic markers for enhancing the feeding value of cereal crop residues for ruminants	ILRI, ICARDA, CIAT, La Trobe University, Australia; NARS of India, Morocco, Tunisia
ACIAR	Management of white grubs in peanut cropping systems in Asia and Australia	NARS of India; Grains Research and Development Corporation, Peanut Company of Australia; University of Queensland, Queensland Department of Primary Industries, Australia
ACIAR	Seeds of Life – East Timor	Australian Center for International Agriculture Research; Catholic Relief Services; World Vision International; IRRI, CIMMYT, CIAT, CIP; Executive Government of East Timor (EGOET)
Muresk Institute	Quantifying the value of grain quality traits in the Indian chickpea market	Muresk Institute of Agriculture
Belgium		
DGIC	Vrije Universiteit Brussel (VUB)/ICRISAT collaborative project on biotechnology	Vrije Universiteit Brussel
DGIC	Towards Sustainability of Groundnut and Cereal Production in West Africa: Management of Peanut Clump Virus	Universite Catholique de Louvain, Belgium; Institut d'etudes et de recherche agricoles (INERA), Burkina Faso; Scottish Crop Research Institute, UK.
Canada		
IDRC	Desert margins initiative (Africa)	NARS and NGOs of Burkina Faso, Kenya, Botswana
CIDA	Improving Income of Farmers in Eastern Africa through Increased Chickpea Yields	University of Saskatchewan, Canada; NARS in Kenya, Tanzania and Ethiopia
CFC	Conservation, evaluation and dissemination of groundnut germplasm and foundation seed production and distribution for the West African Region	CIRAD (France), NARS of Senegal, Burkina Faso, Niger, Nigeria
CFC and World Bank	Preservation of wild species of *Arachis* in South America	CENARGEN (Brazil)
Denmark		
Danida/DANAGRO	Breeding programme for sorghum and millet	NARS of Eritrea
Danida/Eritrea	Kenya-Eritrea Sorghum and Millet Seed Initiative	Danida, Denmark; Ministry of Agriculture, Eritrea.

Donor	Project	Collaborators
European Union (DG XII)	Impact of climate variability on agroecosystems and water resources in drylands	SC-DLO, The Netherlands; IIED, UK; UNIPAD, UNICAIRO, Egypt; ECRI, Egypt; CRICYT, INTA, Argentina; CAZRI, HAU, India; LIPAP, LIGG, IDRAS, GRIWC, China; ACMAD, Niger
FAO	Rapid composting of rice straw	NARS of India
	Integrated Soil and Nutrient Management and Conservation for Farmer Field Schools	University of Zimbabwe, Zimbabwe; Department of Agricultural Technical and Extension Services (AGRITEX), Zimbabwe, Sorghum and Millet Improvement Program (SMIP)
France		
Agropolis	Transgenic Sorghums to Control Stem Borer	International Cooperation Center for Agronomic Research for Development (CIRAD), France.
Germany		
BMZ/GTZ	Promotion of sorghum and millet cultivation in Southern Africa	NARS, NGOs, private sector seed companies, farmers
BMZ/GTZ	Promotion of Leguminosae cultivation (Groundnut) in the SADC region (Phase IV)	NARS in 12 SADC member states, NGOs
BMZ/GTZ	Promotion of Legume Cultivation in Malawi, Mozambique, Zimbabwe and Zambia - Phase V	NARS in Malawi, Mozambique, Zimbabwe and Zambia
BMZ/GTZ	*Striga* resistance in sorghum	University of Hohenheim, Eberhard-Karls Tübingen University (Germany)
BMZ/GTZ	Enhancing the quality, diversity, and productivity of farmers' pearl millet genetic resources in Rajasthan, India	NBPGR, CAZRI, Rajasthan Agricultural University (India), University of Hohenheim (Germany)
BMZ/GTZ	A comparative assessment of community seed supply strategies in Central Tanzania	NARS in Tanzania
IFAD/World Bank	Collaborative research of sorghum-based crop production systems in eastern lowland Wadis of Eritrea	NARS of Eritrea
IFAD	Development of an integrated pest management (IPM) program for the management of pulse pests in southern Asia	Indian Institute of Pulses Research, National Centre for Integrated Pest Management, GB Pant University of Agriculture and Technology, Acharya NG Ranga Agricultural University (India), Centre for World Solidarity, NGOs, ICIPE
	Farmer participatory testing of technologies to increase sorghum and pearl millet production in the Sahel	NARS in Burkina Faso, Ghana, Mali, Niger and Nigeria
Inter-American Development Bank	A research and network strategy for sustainable sorghum production systems for Latin America	NARS of Latin America, CIAT
Iran	Joint collaborative projects and receipt of germplasm for the improvement of pulses production in the arid regions of Iran	NARS of Iran
Iran	Training activities for Iranians at ICRISAT Patancheru	Acharya N G Ranga Agricultural University, Central Research Institute for Dryland Agriculture (CRIDA) (India)
India		
NATP	Identifying Systems for Carbon Sequestration and increased productivity in semi-arid tropical environments	Central Research Institute for Dryland Agriculture (CRIDA), India; Indian Institute of Soil Science, India; National Bureau of Soil Science and Land Use Planning (NBSS&LUP), India
NATP	Aflatoxin Contamination in Groundnut: Mapping and Management in Gujarat, Andhra Pradesh and Adjoining Areas	National Research Center for Groundnut, India; Gujarat Agricultural University, India
NATP	Organic Matter Recyling and Enrichment	Punjab Agricultural University, India; Indian Council of Agricultural Research, India; CCS Haryana Agricultural University, India; Banaras Hindu University, India; GB Pant University of Agriculture and Technology, India
Pvt. Seed Sector Co.	Diversification of Sorghum Hybrid Parents for Asia	Advanta India Ltd., Ganga Kaveri Seeds Pvt Ltd., Hindustan Lever Ltd., J K Agri-Genetics, Mahendra Hybrid Seeds Co. Ltd., Nuziveedu Seeds Ltd., Proagro Seed Co. Ltd.
Pvt. Seed Sector Co.	Diversification of Pearl Millet Hybrid Parents	Advanta India Ltd., Ganga Agri Seeds Ltd., Hindustan Lever Ltd., J K Agri-Genetics; Mahendra Hybrid Seeds Co. Ltd., New Nandi Seeds Corprn., Nuziveedu Seeds Ltd., Proagro Seed Co. Ltd., Shriram Bioseed Genetics India Ltd.

Donor	Project	Collaborators
MAHYCO	Development of cytoplasmic male-sterility in pigeonpea	ICAR, India
Netherlands	Systemwide Resource management for improving and sustaining crop and livestock production on highland Vertisols in Ethiopia	Institute of Agricultural Research, Alemaya University of Agriculture (Ethiopia), ILRI
Netherlands-AP Biotechnology Program	Evolving transgenic sorghum with suitable Bt gene constructs, resistant to stemborer	National Research Center for Sorghum, India, National Research Center on Plant Biotechnology, India
Netherlands-AP Biotechnology Program	Development of disease resistant transgenic pigeonpea	Osmania University, India
Netherlands-AP Biotechnology Program	Genetic Enhancement of Pigeonpea (*Cajanus cajan* (L.) Millspaugh) for Pest Resistance through Interspecific Hybridisation	Osmania University, India; Institute of Public Enterprise, India.
OPEC	Increase groundnut productivity for rural prosperity in Asia	Asian NARS
PLAN International	Groundnut project in Malawi	NARS and NGOs of Malawi
Rockefeller Foundation	Methodology to develop practical soil fertility technologies through farmer/researcher partnerships	NARS of Malawi and Zimbabwe
	Field Phenotyping of Rice Mapping Populations and Exploitation of Synteny between Rice and Sorghum, for Improving Field Response to Drought Stress	Tamil Nadu Agricultural University, India; University of Agricultural Sciences-Bangalore, India; Indian National Rice Biotechnology Network, India.
	IER-ICRISAT Collaborative Project: Guinea Sorghum Hybrids: Bringing the Benefits of Hybrid Technology to a Staple Crop of Sub-Saharan Africa	Institut D'Economie Rurale (IER), Mali
	New Approaches for Technology, Policy and Institutions for Attaining Sustainable Improvements in Soil Fertility Management in Drought-Prone Areas of Zimbabwe	Department of Agricultural Technical and Extension Services (AGRITEX), Zimbabwe; FAO, Italy; Department of Research and Specialist Services, Zimbabwe; University of Zimbabwe, Zimbabwe; Care International, Zimbabwe
	To Conduct Workshop and Training Course on State-of-the-art Field Screening of Cereals, with Emphasis on Rice, for Drought Tolerance	Tamil Nadu Agricultural University, India; University of Agricultural Sciences-Bangalore, India; Indian National Rice Biotechnology Network, India
Switzerland	West- and Central-African millet research network – ROCAFREMI	National extension workers, NGOs and farmers, INTSORMIL
UK		
DFID/CRF	What makes it so tasty for the pest? Identification of *Helicoverpa armigera* (Hübner) feeding stimulants and the location of their production on the pod service of pigeonpea (*Cajanus cajan* (L.) Millsp.)	Natural Resources Institute, UK, Royal Botanic Gardens, UK
DFID/CRF	Safe to eat or why chickens die? Developing low-cost and simple technologies for aflatoxin estimation in foods and feeds	Scottish Crops Research Institute, UK; Janaki Feeds, India, Department of Agriculture, Government of Andhra Pradesh, India
CABI	Principal pod-boring pests of tropical legume crops: economic importance, taxonomy, natural enemies and control	CABI Bioscience, UK; Agricultural College and Research Institute, Madurai, India; Department de Formation en Proctection des Vegetaux, Niger; Universidade Federal do Parana, Brazil
DFID/CRF	Will women farmers invest in improving their soil fertility management? Participatory experimentation in a risky environment	Silsoe Research Institute, UK; NARS and NGOs in Malawi and Zimbabwe
DFID/CRF	Modelling the risk of introducing transgenics into traditional cropping systems: a case study with pigeonpea	University of Birmingham, UK; National Bureau of Plant Genetic Resources, India
DFID/CRF	Genetic enhancement of feed quality and quantity insorghum and millet	International Livestock Research Institute, UK; Indian NARS, Institute of Grassland and Environmental Research, UK; Rowett Research Institute
DFID/NRI	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 N G Ranga Agricultural University, India; University of Greenwich, UK
DFID/CAZS	Contiguous segment substitution lines: new tool for elite pearl millet hybrid parental line enhancement	Centre for Arid Zone Studies, UK; All-India Coordinated Pearl Millet Improvement Project, India; Indian Agricultural Research Institute, India
DFID/CAZS	Use of molecular markers to improve terminal drought tolerance in pearl millet	Institute of Grassland and Environmental Research, UK

Donor	Project	Collaborators
DFID/CAZS	Marker-assisted improvement of pearl millet downy mildew resistance in elite hybrid parental lines for Africa and Asia	CCS Haryana Agricultural University, India; Tamil Nadu Agricultural University, India; Centre for Arid Zone Studies, UK; All-India Coordinated Pearl Millet Improvement Project, India; Central Arid Zone Research Institute, India
DFID/CAZS	Indo-British collaborative project — Participatory varietal selection in Rabi Sorghum	Centre for Arid Zone Studies, UK; and NARS in India
DFID/NRI	Characterization of the causal virus of pigeonpea sterility mosaic disease: a step towards attaining sustainability of pigeonpea production in the Indian subcontinent	Scottish Crop Research Institute, UK; University of Agricultural Sciences, India; Sri Venkateswara University, India
DFID/NRI	Groundnut rosette disease management	Natural Resources Institute, UK; University of Georgia, USA; NARS of Uganda and Malawi
DFID/CAZS	Participatory testing of on-farm seed priming in Zimbabwe	Farmers in two villages of Zimbabwe
DFID/NRI	Review of technical and institutional options for sorghum grain mould management and the potential impact on the poor	Natural Resources Institute, UK; Central Food and Technological Research Institute, India; Long Ashton Research Station, UK
DFID/NRI	Optimising institutional arrangements for demand driven post-harvest research, delivery, uptake and impact on the livelihoods of the poor through public and private sector partnerships	Natural Resources Institute, UK; University of Strathclyde, UK; National Centre for Agricultural Economics and Policy Research, India
DFID/CAZS	Promotion of chickpea following rainfed rice in the Barind area of Bangladesh	University of Wales, UK; Peoples Resource Oriented Voluntary Association, Bangladesh; Bangladesh Agricultural Research Institute, Bangladesh
DFID/CAZS	Assessing Potential for Short-Duration Legumes in South Asian Rice Fallows	University of Wales, UK; NARS in Bangladesh, India, Nepal, Pakistan
DFID/CAZS	Rapid Generation Advance in Photoperiod-Sensitive Sorghum	University of Wales, UK
DFID/CAZS	Rapid Generation of Chickpea Population for Farmer Participatory Selection	University of Wales, UK
DFID/NRI	Promoting the Adoption of the Improved Disease and Pest Management Technologies in Chickpea by Poor Farmers in Mid-Hills and Hill Side Cropping Systems in Nepal	Nepal Agricultural Research Council, Nepal; Natural Resources Institute, UK
DFID/NRIL	Strategies for Reducing Aflatoxin Levels in Groundnut-Based Foods and Feeds in India: A Step towards Improving Health of Humans and Livestock	University of Reading, UK; The Queens University of Belfast, UK; Natural Resources Institute, UK; Acharya NG Ranga Agricultural University, Hyderabad, India; Society for Transformation, Agriculture and Alternatives in Development, Hyderabad, India; Agriculture, Man, Ecology, Bangalore, India
DFID/NRIL	Promotion of an Integrated Pest Management Program for Pigeonpea in India and East Africa	Natural Resources Institute, UK; National Centre for Integrated Pest Management, India; Acharya NG Ranga Agricultural University, India; Marathwada Agricultural University, India; Center for World Solidarity, India; Agricultural Research Institute, Tanzania; Serere Agricultural and Animal Research Institute, Uganda
ODI	Seed Sector Study of Southern Somalia	Overseas Development Institute, UK
UNDP and USA	Impacts of ICRISAT/NARS germplasm research for sorghum, groundnut and pearl millet	Yale University, USA
USA		
USAID/OFDA	Seeds for Freedom. Angola agricultural recovery program: an international, World Vision/CGIAR plan for the rapid recovery of food production systems in Angola	CIAT, CIMMYT, IITA, ISNAR, CIP, World Vision, NARS of Angola, in-country NGOs, and farmers
USAID	Strengthening national agricultural research systems in Africa through collaborative research networks	NARS of participating countries, NGOs, and private sector
USAID	Regional sorghum and millet research project for southern Africa	NARS, NGOs, private sector seed companies, farmers
USAID	Chickpea molecular marker/mapping work	Washington State University (USA)
USAID	Assessing hydrology and crop production in a spatially variable terrain	Michigan State University (USA)

Donor	Project	Collaborators
USAID	Identification of peanut genes and gene products important in the peanut seed	Texas A&M University (USA) / Univ. of Wisconsin-Madison
Texas A&M	Population structure and genetic diversity of *Sclerospora graminicola*: keys to stable production of pearl millet	Texas A&M University (USA)
USAID/OFDA	Fulfilling seed requirements in famine-threatened areas in West Africa: a need for emergency seed distribution	NARS of West Africa
USAID/OFDA	Strengthening drought mitigation work in Southern Africa	NARS of Southern Africa
USAID	Rural prosperity is nation's economic stability: a partnership approach to attain sustainable production of groundnut and pigeonpea in smallholder agriculture for quality diet, household food security, and poverty alleviation in Malawi	Ministry of Agriculture and Irrigation, Malawi; NARS, NGOS and farmers in Malawi
Univ. of Illinois	Strategic marketing of sorghum and millet food products in West and Southern Africa	University of Illinois, USA, NARS in West and Southern Africa
USAID/OFDA	Seeds for survival: increasing the effectiveness of emergency seed aid programs in enhancing seed security in the Greater Horn of Africa	Catholic Relief Services, Uganda; NARS and NGOs in Uganda and Sudan
USAID	Quantifying yield gaps and abiotic stresses in soybean- and groundnut-based rainfed production systems	University of Georgia, USA; SANREM-CRSP, USA.
USAID	Development and mapping of SSR markers for the diversification of rosette virus resistance in groundnut	University of Georgia, USA, Cornell University, USA
USAID	Search for *Striga* resistance in cultivated pearl millet and use of resistance from wild species	University of Georgia, USA; USDA-ARS, USA
USAID	Worskshop on strategies for improving the adoption of seed and fertilizer in Africa	NARS in Africa
USDA	Diversity in the sorghum ergot pathogen in India	Foreign Disease and Weed Science Research Unit, USDA, USA; National Research Center for Sorghum, India
CARE International	Seed Distribution and Production Project (SDPP) in Lower Shabelle Region of Somalia	USAID
Catholic Relief Services	ICRISAT-CRS Collaborative Project in Tharaka and Mbeere Districts	USAID
Consortia of donors (via CGIAR Systemwide Programs)		
IPGRI	Optimizing seed water contents to improve longevity in ex-situ genebanks	IPGRI, University of Reading (UK), National Seed Storage Laboratory (USA), National Genebank of China
ISNAR	Resource use optimization at village and district levels in the desert margins of West Africa	IER, Mali; INERA, Burkina Faso; INRAN, Niger, ICRAF, ILRI, IFDC; ITC and Wageningen Agricultural University, the Netherlands
ILRI	Improving crop-livestock productivity through efficient nutrient management in mixed farming systems of semi-arid West Africa	ILRI, IER, INERA, INRAN, ISRA, IFDC
ICARDA	Research activities on groundnut and on management of drought in chickpea, targeted to the Central Asia and the Caucasus (CAC) region.	ICARDA
IPGRI	Improving the quality and range of data available on ICRISAT's genetic resources collections (SINGER Phase II)	IPGRI
ILRI	Increasing livestock productivity in mixed crop-livestock farming systems in South Asia	ILRI
CIAT	Scaling up participatory plant breeding: Sustainable seed delivery systems for meeting farmers' needs for diversity and varietal change over time	Institut d'Economic Rurale du Mali (IER), Mali; Universite du Mali, Mali; Point Sud, Research Centre on Local Knowledge, Mali; Association Villageoise de Gonsolo, Mali; Compagnie Malienne du Developpement des Textiles (CMDT), Mali.
IITA	System-wide Program on IPM - Pilot Project on IPM in the Sahelian zone	Institut d'Economic Rurale du Mali (IER), Mali; Institut d'etudes et de recherche agricoles (INERA), Burkina Faso

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

Research Scholars

Promising young scientists come to ICRISAT to carry out their research for advanced degrees in the agricultural sciences

Name	Country of Origin	Degree	Topic
Completed during 2000			
At Patancheru			
Michael Krajewski	Germany	MSc	Bio-control rhizobacteria for root-rot fungi
V Kishore Kumar	India	MSc	Host plant resistance in sorghum against stem borer
D Kiran Mayi	India	MSc	Incidence of aflatoxin contamination in selected spice samples of Andhra Pradesh
Sonali Shukla	India	MSc	Evaluation of *Bacillus thuringiensis* and other insecticidal genes for their effectiveness against *Helicoverpa armigera*
G Arvind Reddy	India	MSc	Cultural control of pigeonpea pod borer and its flexibility to fit into IPM
Lakshmi Pathi Srigiriraju	India	MSc	Oviposition behavior and integrated management of *Helicoverpa armigera* in chickpea and pigeonpea
Suvarna	India	MSc	Genotypic response to drought stress in groundnut (*Arachis hypogaea* L.)
K P Nagavallemma	India	PhD	Evaluation of land surface management practices on nutrient budgeting and soil properties of Vertic Inceptisols in soybean-based cropping systems
M Ajitha	India	PhD	Identification and characterization of a core collection for chickpea (*Cicer arietinum* L.) germplasm from the Indian subcontinent
C Sudha Rani	India	PhD	Crop growth and development of castor cultivars under optimal and sub-optimal water and nitrogen conditions in Telangana region
Geetha Senthil	India	PhD	Enhancement of resistance to *Botrytis* gray mold of chickpea using PGIP genes
K Kanaka Durga	India	PhD	Cytoplasmic systems and hybrid type studies on yield characters in sorghum
K Thirumala Devi	India	PhD	Development of cost-effective and simple ELISA-based technologies for the estimation of aflatoxins and ochratoxin A in foods and feeds
M Bharathi	India	PhD	Integrated disease management of wilt (*Fusarium udum* Butler) of pigeonpea (*Cajanus cajan* (L.) Millsp.)
P Lava Kumar	India	PhD	Studies on pigeonpea sterility mosaic disease: Isolation and characterization of the causal agent and assessment of genetic variation within and between populations of the mite vector, *Aceria cajani*
T Shyamala Rani	India	PhD	Tissue culture studies in pearl millet (*Pennisetum glaucum* (L.) R.Br.) with special reference to in vitro doubled haploids production
S H Sabaghpour	Iran	PhD	Genetic studies on qualitative and quantitative traits in chickpea (*Cicer arietinum* L.).
Ranjana Bhattarcharjee	India	PhD	Studies on the establishment of a core collection of pearl millet (*Pennisetum glaucum*) germplasm
Continuing during 2000			
V Muthusubramanian	India	MSc	Studies on diversity of sorghum ergot pathogen isolates occurring in India
G Raghu	India	PhD	The effect of earliness gene efl-1 on chickpea traits
Kamala Venkateswaran	India	PhD	Genetic and molecular characterization of wild and cultivated species of sorghum for transferring resistance to biotic stresses
B U Singh	India	PhD	Host plant resistance to shoot fly, stem borer, or head bug in sorghum
A Sunitha Daniel	India	PhD	Groundnut transformation for GRAV resistance by using coat protein and satellite genes
B Sandhya	India	PhD	Genetic transformation of groundnut with chitinase and glucanase
P Azhaguvel	India	PhD	Mapping and marker-assisted backcross transfer of downy mildew resistance in pearl millet
G Sunitha Dayal	India	PhD	Genetic transformation studies in pigeonpea
R Sucharitha	India	PhD	Simulation of the effects of the manure quality, soil type, and climate on nitrogen and phosphorus supply to sorghum and pigeonpea in semi-arid tropical India
K Anupama	India	PhD	Genetic and molecular markers in chickpea
B Pushpavathi	India	PhD	Variability of *Sclerospora graminicola*
D Harsha Vardhan	India	PhD	Biotechnological approaches for development of disease resistance on sorghum
V Visalakshmi	India	PhD	Effect of IPM components on natural enemies in chickpea with special emphasis to NPV

Name	Country of Origin	Degree	Topic
Arun Sharma	India	PhD	Marker-assisted improvement of pearl millet (*Pennisetum glaucum* L.) downy mildew resistance in elite hybrid parental line H77/833-2
Renuka S Singru	India	PhD	Molecular studies on plant pathogen interaction in pearl millet downy mildew
V Maruthi	India	PhD	Evaluation of suitable cropping systems under different land management practices in a Vertic Inceptisol watershed
B Jayanand	India	PhD	Regeneration in chickpea
K Srinivas	India	PhD	Simulation modeling of the soil-plant system
T Srinivas	India	PhD	On-farm evaluation of IPM of *Helicoverpa armigera* on chickpea
Joined during 2000			
Gurjeet Singh Kang	India	MSc	Soil-biological indicators of sustainability of rice-wheat cropping system
Maurice Muise	Canada	MSc	Is there a link between access to common property resources and casual wages? Evidence from rural India
S Karthikeyan	India	MSc	Field phenotyping of rice under defined drought conditions
V S S Kiran Kumar	India	MSc	Chickpea genetics
Naveenkumar Kulkarni	India	PhD	Pigeonpea sterility mosaic disease: transmission, virus-vector relationship and identification of resistant sources
Jagdeep Singh	India	PhD	Epidemiology and host-plant resistance for management of *Botrytis* gray mold (BGM) of chickpea
D Anitha Kumari	India	PhD	Mechanisms and diversity of resistance to *Helicoverpa* in pigeonpea
Cho Seungho	Korea	PhD	Genetic mapping of chickpea using STMS markers and analysis of data using linkage mapping softwares
E Sree Latha	India	PhD	Stability, mechanisms and inheritance of resistance to *Helicoverpa* pod borer in chickpea
G V Naveen Sharma	India	PhD	DNA markers, microsatellites silver staining and BSA.
B Ramachandra Sarosh	India	PhD	Molecular aspects of induced systemic resistance and molecular genetics in pearl millet against the downy mildew pathogen *Sclerospora graminicola*
G M Sajjanar	India	PhD	Genetic analysis of different components of resistance to shootfly (*Atherigona soccata*) in sorghum (*Sorghum bicolor* (L.) Moench)
J Sailasree	India	PhD	Microbiological and molecular characterization of microorganisms for the management of *Helicoverpa armigera*
G Sujana	India	PhD	Studies on mechanisms of resistance to pod borer in wild relatives of pigeonpea [*Cajanus cajan* (L.)]
R Aruna	India	PhD	Wide hybridization of *Cajanus cajan* involving compatible wild species
D Prabhakar Reddy	India	PhD	Introgression of pod borer resistance into pigeonpea (*Cajanus cajan*) using incompatible wild relatives
Y Chandrahasa Reddy	India	PhD	Evaluation of Bt toxins against *Helicoverpa*
B Santha	India	PhD	Tissue culture and genetic transformation of dryland cereals with emphasis on pearl millet
Ch Anuradha	India	PhD	Genetics and molecular marker studies in chickpea (*Cicer arietinum* L.)
Dev Vart	India	PhD	Genetics of cytoplasmic-nuclear male sterility and molecular markers of fertility restorer genes in pearl millet (*Pennisetum glaucum* (L.) R.Br.)
Ananda Vadivelu	India	MPhil	An empirical analysis of the relationship between size, ownership and productivity of farms in a watershed area in Madhya Pradesh.
At Niamey, Niger			
Maman Bachir Magagi	Niger	MSc	Ecology of an invading species: *Sida cordifolia*
Guimba Guéro	Niger	BS	Study of the effect of temperature, moisture, oxygen and CO_2 on seed viability
Hima Hama Ousmane	Niger	MSc	Impact of soil fertility on crop production in Karabedji village
Zalagou M. Aissa	Niger	MSc	Livestock marketing and economy in Western Niger
Hamidou Zeinabou	Niger	PhD	Use of phosphorus absorption iso-themes
Mounkaila Mohamed	Niger	PhD	Role of clay in semi-arid soils
Soumana Boubacar	Niger	MSc	Impact study of credit on the use of mineral fertilizers
Issoufou Mahamadou	Niger	MSc	Improvement of insect rearing techniques
Emilie Stuber	France	MSc	In situ evaluation of micro-dose fertilizer technology at the landscape scale
Ellen Winters	USA	MSc	Impact study of credit on the use of mineral fertilizers

Name	Country of Origin	Degree	Topic
Sandra Schnock	Belgium	MSc	The role of viruses in groundnut growth spatial variability
Gregory Herman	Belgium	MSc	Contribution to the study of wind erosion fluxes between fallow and cropland
Haoua Sissoko	Mali	PhD	Improved fallow management in the sub-humid Mali
Roberto La Rovere	Italy	PhD	Exploration of the roles of livestock husbandry in mixed farming systems in the Sahel through the adaptation of a multi-goal linear program model
Bakary Djaby	Burkina Faso	PhD	Use of remote sensing tools in GIS devoted to natural resource management in the CILSS countries
Brigitte Gnoumou	Burkina Faso	PhD	Animal nutrition and nutrient recycling in villages of Western Niger
Thomas Lecorguillé	France	MSc	Remote sensing of woody plant population in Western Niger
Bello S. Malami	Nigeria	PhD	Range management in Zamfara reserve
Siaka Boureima	Niger	PhD	Potential of pearl millet top-cross hybrids in Niger
At Bamako, Mali			
Ibrahima Diallo	Mali	MSc	Comparative study of development and growth of three sorghum varieties sown at two different dates
Ana Dolo	Mali	MSc	Evaluation of converted pearl millet landraces from Burkina Faso for reaction to *Striga hermonthica*
Oumar Tamboura	Mali	MSc	Identification of resistance sources to sorghum anthracnose in Mali
Sadou Ongoïba	Mali	MSc	Intensification of integrated crop-livestock system using improved agronomic practices of sorgho-cowpea intercropping: Koulikoro Region
Almouner Ag Alhamis Yattara	Mali	MSc	Screening for resistance of some sorghum mutants to field and storage insect pests
Soualika Boiré	Texax	PhD	Assessment of mortality and life tables for millet head miner (Lepidoptera : Nocturae) in Niger
Ousmane Yaya Sanogo	Mali	MSc	On-farm development and validation of IPM techniques for sorghum panicle bugs
Mahamadou Diarra	Mali	MSc	Soil fertility management practices by farmers in Koulikoro Regions: current practices, constraints and opportunities
Tidiane Diarrisso	Mali	MSc	Local village sorghum and groundnut seed systems
Tite Diarra	Mali	MSc	Initial evaluation trial of groundnut progenies for resistance to foliar diseases and productivity
Mamoudou Tigana	Mali	MSc	Gestion Intégrée des maladies foliaires: la rosette de l'arachide
Maïmouna Diallo	Mali	MSc	Etude de variabilité génétique dans les variétés locales de sorgho
Oumar Pascal Togola	Mali	MSc	Tests variétales de sorgho dans le Cercle de Nara, Commune de Fallou (en collaboration avec l'ONG Stop-Sahel)
Soriba Diakité	Mali	MSc	Etude d'un processus de changement variétal de sorgho en milieu paysan: Cas du Village de Gonsolo (Commune de Bancoumana)

Workshops, Conferences, Training Courses during 2000

ICRISAT convened skills-sharing events around the world in 2000 to build scientific capacities for sustainable agricultural development

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
Workshops/Meetings				
Mini-Symposium on Watersheds, 18 Jan	ICRISAT-Patancheru	15	India, Niger	ICRISAT
ILRI/NUTMAN Steering Committee Meeting, 3-4 Feb	Ouagadougou, Burkina-Faso	10	IFAD, IDRC, ILRI, ICRISAT, IFDC, IER, INRAN, ISRA	ILRI/NUTMAN
ICAR-ICRISAT Collaborative Workshop on Impact of Agricultural Research in India, 10-11 Feb	ICRISAT-Patancheru	55	ICAR	NCAP/ICRISAT
ICAR-ICRISAT SEPP Workshop for Developing workplan for the Year 2000, 12 Feb	ICRISAT-Patancheru	34	ICAR	ICRISAT
Project Planning Matrix Workshop, 14-16 Feb	ICRISAT-Lilongwe	12	Malawi, Kenya, Germany, Mozambique, Zambia	SADC/ICRISAT
IFAD Project National Coordinators' Meeting 28-29 Feb	ICRISAT-Bamako	16	IER, INRAN, IAR, FRI, INERA, IFAD, ICRISAT	IFAD-ICRISAT
Meeting on Towards Sustainability of Groundnut and Cereal Production in West Africa: Management of Peanut Clump Virus, 29 Feb-1 Mar	ICRISAT-Patancheru	16	DGIC UCL, SCRI, India, Mali	DGIC funded project
Pulses IPM Project Progress Review Meeting, 1-2 Mar	ICRISAT-Patancheru	50	India	IFAD
IFAD-ICRISAT-NARS Pulse IPM project Review Meeting, 1-2 Mar	ICRISAT-Patancheru	30	India	IFAD-ICRISAT-IPM Project
Meeting to Review and Plan the SLP Project on Integrated Crop-livestock Systems in Mali, 13-16 Mar	ICRISAT-Bamako	20	Mali, Nigeria, Niger, Ethiopia, UK; IER, ICRISAT, ILRI, IITA, IFDC, CORD	Systemwide Livestock Program (SLP)
Annual Workshop, ROCAFREMI, 22-28 Mar	ICRISAT-Niamey	50	Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Gambia, Ghana, Mali, Niger, Mauritania, Nigeria, Senegal, Togo, Chad, USA, France	ROCAFREMI
Workshop on Coping with New Policy Agendas for Agricultural Research: Institutional Implications, 28 Mar	ICRISAT-Patancheru	27	ANGRAU, NAARM, CESS, ASCI	DFID
Ex-ante Evaluation of Nutrient Management Technologies in Mixed Crop Livestock Production Systems, 24-28 Apr	ICRISAT-Niamey	18	ILRI, ICRISAT, IFDC, IER, INRAN, ISRA	ILRI / NUTMAN
Working Group Meeting on Carbon Sequestration, 16-17 May	ICRISAT-Patancheru	20	IISS, NBSS&LUP, CRIDA, ICRISAT	NATP funding
Consultative Group Meeting on Technical and Institutional Options for Sorghum Grain Mold Management 18-19 May	ICRISAT-Patancheru	28	India, UK, USA, West Indies	DFID, ICRISAT
Workshop on *Striga* research in Southern Africa and Strategies for Regionalized Control Options: a Regional SADC *Striga* Working Group Workshop, 22-23 May	Tanzania	17	Botswana, Malawi, Mozambique, Sudan, Tanzania, UK, Zimbabwe.	ICRISAT/SMINET

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
IFAD Project Steering Committee Meeting 1-2 Jun	ICRISAT-Bamako	25	IER, INRAN, IAR, FRI, INERA, IFAD, ICRISAT	IFAD-ICRISAT
Participative Selection, 7-11 Jun	Maradi, Niger	20	Niger, Burkina Faso	ROCAFREMI-ICRISAT
Brainstorming Session on Desertification, 8-9 Jun	ICRISAT-Patancheru	25	CAZRI, NBSS&LUP, NRCA, ICAR, CRIDA, NRSA, ANGRAU, ICRISAT, and NRSP	ICRISAT, NRSP, UK.
Steering Committee and Global Environmental Facility Meeting, 13-15 Jun	ICRISAT-Niamey	20	Austria, Botswana, Burkina Faso, Canada, Kenya, Mali, Namibia, Niger, Senegal, Uganda, Togo, UK, USA,	ICRISAT / DMP
CFC Steering Committee meeting, 3-6 July	ICRISAT-Niamey	9	Burkina Faso, Mali, Niger, France, Senegal, ICRISAT	ICRISAT / CFC
Follow-up Meeting of the Working Group on Desertification 18 July 2000	ICRISAT-Patancheru	4	CAZRI, CRIDA, ICRISAT	ICRISAT
Meeting on Strategies for Reducing Aflatoxin Levels in Groundnut-based Foods and Feeds in India: A Step Towards Improving Health of Humans and Livestock, 26-27 Jul	ICRISAT-Patancheru	20	UoR, AME, STAAD, NARS (NRCG, ANGRAU), NGOs	DFID-funded project
Incremental Cost and Log Frame Analysis, 7-9 Aug	ICRISAT-Niamey	15	NARS from Burkina Faso, Mali, Niger, Senegal, ICRISAT	DMP / GEF
Monitoring Tours for Projects P6, P7, and P5 – ROCAFREMI, 14-18 Aug, 16-28 Sep, 11-19 Oct	Togo, Niger, Mali	9	NARS from Burkina Faso, Senegal, Niger, Côte d'Ivoire, Mali, Nigeria	ROCAFREMI
Traveling Workshop-cum-Field Visit to Benchmark Watersheds, 27 Aug-12 Sep	VASI, Vietnam; KKU, Bangkok, BAIF, Bhopal, IISS, Bhopal, ICRISAT-Patancheru	9	IISS, BAIF, JNKVV, CRIDA, KKU, Department of Agriculture, Thailand, VASI, and ICRISAT	Asian Development Bank, Manila, Philippines
Program Integration Meeting: ICRISAT/IITA/WARDA: 11-14 Sep	ICRISAT-Bamako	9	Mali, Côte d'Ivoire, Benin, Nigeria	ICRISAT, WARDA, IITA
Planning Meeting of Phase V of the SADC/ICRISAT, 12-15 Sep	ICRISAT-Lilongwe	27	Malawi, Mozambique, Zambia, Zimbabwe	SADC/ICRISAT
Seminar-cum-Workshop on IPM on Pigeonpea ICRISAT-Indian Crop Protection Association (ICPA) - Training Program, 22 Sep	ICRISAT-Patancheru	40	India	ICRISAT-ICPA
The Global 2000: Sorghum and Pearl Millet Diseases III, 24-29 Sep	Guanajuato, Mexico	130	From 21 Countries	INTSORMIL, INIFAP, ICRISAT
Groundnut Breeders' Meet, 3-4 Oct	ICRISAT-Patancheru	14	India	ICRISAT/ICAR
NRMP CCER meeting, 8-10 Oct	ICRISAT-Bamako	4	Mali, Niger, India, Zimbabwe, Vietnam	ICRISAT
Regional Workshop on Status and Potential Pigeonpeas in Eastern and Southern Africa, 12-15 Oct	Nairobi, Kenya	30	Kenya, Uganda, Tanzania, Malawi ARI: University of Bonn and University of Gembloux; NGOs: TechnoServe, Catholic Relief Services	ICRISAT, European Union (INCO-DEV Programme), CIUF, Univ. of Nairobi, Makerere Univ., Univ. of Gembloux and Univ. of Bonn.
Workshop on Sorghum Processing and Utilization, 12-18 Oct	Cinzana/Ségou, MALI	40	Burkina Faso, Chad, Gambia, Ghana, Mali, Niger, Nigeria, Togo	WCASRN

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
Integration of Date Palm Tree in West Africa Gardens, 24-26 Oct	ICRISAT-Niamey	30	Burkina Faso, Mali, Niger, Senegal, Canada, ICRISAT	DMP/IPALAC/INRAN
Seminar-cum-Workshop on Integrated Crop Management on Groundnut, 31 Oct	ICRISAT-Patancheru	60	India	ICRISAT-ICPA
ICRISAT Work Planning Meeting, 12-18 Nov	ICRISAT-Patancheru	9	India	ICRISAT
International Symposium on Future of Agriculture in Semi-Arid Tropics, 14 Nov	ICRISAT-Patancheru	60	ICAR, IRM, DFID, FAO, World Bank	ICRISAT
Increased Crop Productivity and Livestock Production through Nutrient Improved Management in WA Mixed Farming Systems. Annual Technical Committee Meeting, 16-18 Nov	ICRISAT-Niamey	20	ILRI, ICRISAT, IFDC, IER, INRAN, ISRA	ILRI / NUTMAN
Review and Planning Meeting for ADB-Project Improving Management of Natural Resources for Sustainable Rainfed Agriculture, 27-29 Nov	ICRISAT-Patancheru	30	IISS, BAIF, JNKVV, CRIDA, DPAP, NRSA, MVF, ADB, KKU, IBSRAM, Department of Agriculture, VASI, and ICRISAT	Asian Development Bank, Manila, Philippines
7th Regional Groundnut Workshop for West and Central Africa, 6-8 Dec	Cotonou, Benin	40	West African countries, France, India, Peanut CRSP and USA universities	ICRISAT, Peanut CRSP, CORAF and S G 2000.
International Workshop on Field Screening for Drought Tolerance in Rice, 11-14 Dec	ICRISAT-Patancheru	50	India, Côte d'Ivoire, Zimbabwe, Israel, Thailand, Philippines,	Rockefeller Foundation, USA
ROCAFREMI Steering Committee Meeting, 11-12 Dec	ICRISAT-Niamey	12	Niger, Burkina Faso, Mali, Senegal, Togo, Gambia, Suisse, ICRISAT	ROCAFREMI
Atelier de Réflexion Bilan Acquis et Perspectives de la Recherche sur le Mil dans les pays de la sous-région, 13-15 Dec	Cotonou, Benin	25	Niger, Burkina Faso, Mali, Senegal, Togo, Gambia, Suisse, ROCARS, INRAB	ROCAFREMI
Joint meeting ROCARS - ROCAFREMI, 16 Dec	Cotonou, Benin	11	Suisse, Togo, Burkina Faso, Senegal, Mali, Niger	ROCAFREMI
Training Courses				
Experimental design & data analysis using Genstat Windows, 27-28 Jan	ICRISAT-Patancheru	11	India	ICRISAT
Genetic mapping and QTL analysis, 31 Jan-1 Feb	ICRISAT-Patancheru	12	India	ICRISAT
Genetic mapping and QTL analysis, 21-23 Feb	ICRISAT-Patancheru	12	India	ICRISAT
CRESA/Université Abdou M. Dioffo (Niger) Students, 1 Jun	ICRISAT-Niamey	25	CRESA (University of Niamey), ICRISAT	ICRISAT
Pigeonpea Production Technologies, 17-19 Jul	ICRISAT-Lilongwe	47	Malawi	ICRISAT-DARTS-USAID Project on Groundnut and Pigeonpea
HNPV, 31 Jul - 4 Aug	ICRISAT-Patancheru	2	India	IFAD-ICRISAT IPM project
Application of Information Technologies for ICAR/SAU Librarians, 4-16 Sep	ICRISAT-Patancheru	13	India	ICAR
How to write a winning proposal, 17-29 Sep	ICRISAT-Niamey	25	Netherlands, England, Côte d'Ivoire, Mali, Niger, Burkina Faso, Togo, Benin, Senegal, Cameroon, Burundi	ISNAR / ICRISAT

Event/Topic/Date	Location	Participants	Participating countries/Institutes	Resources and collaborative support
Site Stratification Analysis for Regionalized Breeding, 18-22 Sep	ICRISAT-Bulawayo	15	SADC NARS, ICRISAT	SMIP/ICRISAT
Seed production, 18-23 Sep	ICRISAT-Bamako	18	Benin, Burkina Faso, Chad, Gambia, Mali, Mauritania, Nigeria, Sierra Leone, Togo	WCASRN
Conducting Semi-structured Interviews within the SLP Dry Savannah Project, 18-21 Sep	ICRISAT-Niamey	12	ILRI, ICRISAT, IFDC, IITA	ILRI / SLP
Semi-structured Interviews Methodology for SLP Project on Crop-livestock Systems in Mali, 25-28 Sep	ICRISAT-Bamako	15	Mali, Nigeria, UK	Systemwide Livestock Program (SLP)
IPM and NPV production, 17 Oct	ICRISAT-Patancheru	6 l	India	
Project Management Course, 18 Oct-11 Nov.	ICRISAT-Niamey	6	Benin, Burkina Faso, Mali , Niger	WCASRN
Agricultural Research Management, 29 Oct -11 Nov	ICRISAT-Niamey	25	INRAN Niger	ISNAR / ICRISAT
IPM and NPV production, 1 Nov	ICRISAT-Patancheru	5	India	IFAD-ICRISAT IPM project
Impacts of Variability of Natural Resources on the Performance of Community Scale Watersheds, 16-29 Nov	ICRISAT-Patancheru	9	India, Thailand, and Vietnam	Asian Development Bank (ADB)'s Project on "Improving Management of Natural Resources for Sustainable Rainfed Agriculture"
Production and use of *Helicoverpa armigera* (Hübner) NPV for IPM of Chickpea, 10-20 Dec	Rajshahi, Bangladesh	20	BARI, Bangladesh	DFID-ICRISAT Barind project and facilitated by People's Resource Oriented Voluntary Association (PROVA)

The Chronicle

Established 1894 Bulawayo, Wednesday, February 21, 2001

A SCIENCE with a human face is empowering rural Zimbabweans to fight hunger and poverty, an official of the International Crop Research Institute for Semi-Arid Tropics said in Bulawayo yesterday.

Speaking in an interview with *The Chronicle*, the director-general of ICRISAT, Dr William Dar, said the Matopos Research Station, run by the institute, had developed 46 varieties, and amassed 75 000 gene extracts, of stress-tolerant sorghum and millet since 1984.

"The semi-arid tropics is home to more than 800 million people. At least 300 million of thes people are hungry, poo and at the mercy changing climatic pa terns. Research into n crop varieties he communities to h better yields, thus bo ing their food secur he said.

Matopos station, him Zakara is a connoisseur of side Bulawayo, is t dust.

gional centre for The old farmer, a Bella tribes- and Southern Afri man whose ancestors once the world headqu roamed the Sahara as nomads, for ICRISAT's e knows the fine grit that blows ics unit. across his parched fields can be

It was establi good: It is a natural fertilizer. 1984 and employ entists in the fields genetics resource enhancement, natural resource management and economics.

Chicago Tribune

SUNDAY, MARCH 25, 2001

Time bomb ticking at Earth's arid edges

By Paul Salopek
Tribune foreign correspondent

AMASSAGAL, Niger—Ibra-

"The main difference between an African farmer and one in the American West is that the American is living on borrowed time," said Barry Shapiro, a land use expert with the International Crops Research Institute for the Semi-Arid Tropics, an organization devoted to improving food production in semideserts.

The Wall Street Journal January 19, 2001

Farmers Agree Things Go Better With Coke: Fertilizer, for Starters

* * *

In Niger, Soda's Bottle Caps Are Ideal-Size Dispensers, Leading to Record Yields

By Betsy McKay
Staff Reporter of The Wall Street Journal

For some 5,000 farmers in the West African nation of Niger, Coke is it. Or at least Coke bottle caps are.

Despite poor sub-Saharan soil and drought conditions, the farmers are harvesting some record crops of millet, a local staple, thanks to a new technique in which they use metal Coca-Cola bottle caps to dispense small doses of fertilizer on their plants.

THE TIMES OF INDIA, TUESDAY, MARCH 20, 2001 3

Icrisat's new governing board chief

The Times of India News Service

HYDERABAD: Martha B Stone has taken over as the chief of the Governing Board of the International Crops Research Institute for the Semi-Arid Tropics (Icrisat) on March 13,

Martha Stone

THE chairperson of the ICRISAT board of governors, Dr Ragnhild Sohlberg (le director-members during an annual general meeting yesterday while the direc eral, Dr William Dar, looks attentively.

NEWSTIME

Babu seeks Icrisat help to implement model project

Newsday

Hyderabad: Chief minister N Chandrababu Naidu has called for a collaborative venture between the state government and the international crop research institute for the semi-arid tropics (Icrisat) to implement suitable agricultural technologies and practices to benefit the poor and marginal farmers.

Speaking at the Icrisat annual day celebrations at Patancheru on Thursday, the chief minister asked minister for agriculture Vadde Sobhanadreeswara Rao to utilise the talent, technologies and practices that were available with Icrisat to implement a model project which could be replicated elsewhere.

Naidu said the challenge before the scientists was how to extend the benefits of new farm technologies to the poor and marginal farmers in a cost-effective manner as China was doing. It was also important to integrate field work with research.

Dwelling at length on the farm experiments being conducted in his constituency, Kuppam, the chief minister said he was keen to see the MRP to farmers. Towards this end a State agricultural productivity council had been formed, district committees set up, research stations established in every district and incentives like awards to the farmers given.

Director-general of Icrisat, Dr William D Dar said the institute was involved in two emerging technologies being given a push by the chief minister — biotechnology and information technology. The institute was looking forward to teaming up with the state government to u

NATION • NATION

VISITE PRÉSIDENTIELLE À ICRISAT

Alpha constate les réalisations

Le Président de la République vient d'effectuer une visite dans les installations agricoles de l'ICRISAT, le jeudi 12 octobre 2000. Accompagné de son Excellence El Madani Diallo, ministre du Développement Rural, Alpha Oumar Konaré a visité des réalisations de recherche de l'ICRISAT. Arrivé à l'ICRISAT à 9 heures 00, le Président de la République a été reçu par le Docteur Farid Waliyar, Représentant résident de l'ICRISAT au Mali entouré de ses collaborateurs. Les villages de Samaya et de Samanko

Alpha Oumar Konaré en compagnie du Dr Farid Waliyar

Alpha Oumar Konaré

Président de la République du Mali, c'est un grand honneur pour nous, de vous recevoir dans notre station de recherche au Mali. Votre visite à l'ICRISAT témoigne de l'excellent appui du gouvernement du Mali à l'endroit de l'ICRISAT et nous vous en sommes reconnais

rables dans les zones trop semi-arides. «Nous tradu cette mission par la rec avec un visage humai M. Waliyar dans son d de bienvenue.

Avant de commencer des champs, Alpha Konaré s'est adressé

4 THE HINDU

ICRISAT scientists' breakthrough in creating hybrid pigeonpea

By Our Special Correspondent

HYDERABAD, FEB. 2. Scientists of the International Crop Research Institute for Semi Arid Tropics (ICRISAT) and its partner institutions are on the verge of creating the world's cytoplasmic male (CMS) hybrid pigeonpea which could create a big leap in farmers' earning incomes. Pigeonpea is a major component in Indian diets and also widely

The fertility restoration system, a second vital component of technology, has also been established, thus clearing the way for developing the first cytoplasmic male sterility (CMS)-based pigeonpea hybrid in the near future. According to Dr.K.B.Saxena, Senior Scientist (Breeding) of ICRISAT, pigeonpea hybrids can increase

Private sector to invest in Icrisat

HYDERABAD: Fourteen small and large seed enterprises in private sector have pledged $ 109,000 annually to help support public plant breeding research at the Icrisat here, whose farm-related research had helped farming community in general and seed industry in particular.

The financial aid from the private sector to carry on the on-going research activities of Icrisat assumes significance in view of continuing ...sistance to the developing countries in agricultural research.

Global enterprises along with a number of home-grown seed companies such as Advanta India, Cosmo, Ganga Kaveri Seeds, Hindustan Lever, JK Agri Genetic, Mahendra Hybrid Seeds Co, Mayco, New Nadi Seeds Corporation, Pioneer, Prabhat Agri Biotech and Shriram Bioseed Genetics India have pledged the support, an official release of Icrisat said on Wednesday.

Private firms fund ICRISAT research

HYDERABAD: In the wake of the continuing decline in Western assistance to developing countries for agricultural research, a coalition of small and large seed enterprises in India has come forward to fill the breach.

Fourteen countries have pledged $ 100,000 annually to support applied plant breeding research at ICRISAT for five years. All material developed through this research will remain as international public goods, freely available to all, according to an ICRISAT press release.

The companies committed to the coalition include Advanta India, Cosmo, Ganga Kaveri Seeds, Hindustan Lever, J.K.Agri Genetics, Mahendra Hybrid Seed Co, MAHYCO, New Nandi Seeds Corporation, Pallantgene, Proagro Seed Co, Prabhat Agri Biotech and Shriram Bioseeds Genetics India.

The research focuses on key issues like diversifying the genetic

New Scientist January 27, 2001

Bottle it

AT LEAST 5000 poor farmers in Niger have been saved from ruin with the help of cola bottle caps. Last year's drought should have devastated harvests of millet. Instead, yields doubled thanks to a project organised by the Sahelian Centre of the International Crops Research Institute for the Semi-Arid Tropics in Niamey.

To fortify the soil, farmers added "microdoses" of fertiliser to their plants with the bottle caps. The caps hold 6 grams of fertiliser, enough for every two or three plants

HE HINDU, Friday, December 8, 2000 *5 CITY/REGIONAL

CM seeks partnership with ICRISAT

By Our Special Correspondent

HYDERABAD, DEC. 7. The Chief Minister, Mr. N. Chandrababu Naidu, today invited the ICRISAT for a partnership with the A. P. Government in evolving a cost- effective agricultural technology for farmers that could serve as a model for the developing world.

He was speaking at the annual day of the International Crops Research Institute for Semi-Arid Tropics (ICRISAT), which has earlier provided assistance to AP in implementing watershed- based technologies for water harvesting and, more recently, provided groundnut seeds resistant to bud necrosis disease which ravaged Anantapur district.

The Chief Minister, Mr. N. Chandrababu Naidu, launching the first issue of ICRISAT's millennium e-newsletter at the annual day function held at Patancheru,near Hyderabad, on Thursday. The ICRISAT Director-General, Dr. William D. Dar, is on his left. — Photo: Mohd. Yousuf.

Mali — L'ESSOR

L'ICRISAT RÉUSSIT LA RÉVOLUTION VERTE

En 27 ans l'Icrisat a aidé à la diversification de l'agriculture africaine. Il continue cependant son combat pour la sécurité alimentaire

Dans le cadre de la 43è session de son conseil d'administration l'Institut international de recherche sur les cultures des zones tropicales semi-arides (Icrisat) a tenu vendredi dernier au Grand Hôtel une journée de partenariat. placée sous la présidence du secrétaire général du ministère du Développement rural et de l'Eau (MDRE) Mamadou Goïta. C'était en présence du directeur général d'Icrisat Dr William D. Dar, de la présidente du conseil d'administration Ragnhild Sohlberg et d'une trentaine de ...

reconstruire son économie agricole en renforçant ses cultures de sorgho. Le Dr William D. Dar rappellera également qu'en Afrique orientale et australe, l'Icrisat a aidé à vulgariser la culture du pois d'Angole, et qu'en Afrique occidentale, les variétés de sorgho de l'institution ont eu un impact lent mais certain, en diminuant l'impact de la sécheresse, des ravageurs et autres contraintes liées à la production de la céréale.

L'ICRISAT OUVRE ...

Sahel Dimanche — Dossier

recherche agronomique

Des succès malgré tout
ICRISAT, 19 ans d'existence

Par Abdou Saïdou

...entre sahélien de l'Institut International de Recherche sur les Cultures des Zones tropicales semi-arides (ICRISAT) de Sadoré (Say) à 30 km au sud de Niamey. Il était 8h10 en ce lundi 11 décembre quand notre véhicule s'immobilisa devant le bâtiment de cette organisation internationale. La première impression qui se dégage c'est le silence absolu qui règne dans la cour. Aucun mouvement de va-et-vient ne laisse croire à un ...

à la création de semences améliorées. Il en est de même pour les autres variétés comme le sorgho et l'arachide et bien d'autres. Le tout conservé dans une banque de gènes au niveau du Centre ICRISAT de Sadoré. La spécificité du Niger a conduit cet institut à orienter ces recherches sur le petit mil, le sorgho et l'arachide, mais il n'en demeure pas moins que d'autres recherches sont effectuées ...

La vulgarisation, le maillon faible

En 19 ans d'existence au Niger, l'ICRISAT reste encore très peu connu du monde paysan. Et pour cause. Pour se faire connaître, il faut avoir un volet vulgarisation. Or, tel n'est pas le cas de l'ICRISAT. Pour pallier cette insuffisance, il a établi une étroite col...

TIMES OF INDIA, HYDERABAD

Icrisat develops molec... map for chickpea

The Times of India News Service

HYDERABAD: International Crop Research Institute for Semi-Arid Tropics (Icrisat) at Patancheru here in partnership with Washington State University has made significant advances in developing the World's first mol...

and protein for th... Asia, Middle Ea... Africa, about 90 ... chickpea is grown i... tions and it always... stress.

So to increase d...

BIO TECH international

Pigeonpea Breakthrough

A breakthrough could improve the plight of millions of peasant farmers across the Indian Subcontinent. Crop experts at the Scottish Crop Research Institute (SCRI) have identified what is believed to be the cause of Pigeonpea Sterility Mosaic Disease (PDSM). The disease destroys millions of acres of protein-rich pigeonpea every year. The SCRI unit has been working with scientists at the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) in an effort to develop new disease resistant varieties of pigeonpea and has secured a grant from the ... Development to further ...

THE RISING NEPAL

Nepal can cash in on chickpea cultivation

BY A STAFF REPORTER

Kathmandu, Sept 7:

The workshop on "Planning And Implementation of On-Farm Chickpea IPM in Nepal concluded today emphasising the need to promote seed multiplication and to popularise the crop among the farmers through successful on-farm demonstrations.

The workshop called upon the NGOs and the scientists working at the research stations in different parts of the Nepal to join hands in changing the outlook of the farmers towards chickpea cultivation.

"Efforts need to be directed towards converting Chickpea into a cash crop from its present status of subsistence crop," Dhruva Joshi, Executive Director of the National Agricultural Research Council (NARC) told the concluding session of the workshop.

... of seeds needs to be given due ...

NEPAL: Workshop in chickpea held

for Nepal whereby the income levels of the families can be increased and the food security of Nepal can be enhanced," Stevenson said.

NARC came up with a pragmatism strategy of involving the farmers in the workshop to assess their needs and problems. ...

Icrisat identifies virus affecting groundnut

THE TIMES OF INDIA, HYDERABAD, SATURDAY, FEBRUARY 10, 2001

The Times of India News Service

HYDERABAD: The virus that devastated groundnut crop in over 2.5 lakh hectares in Rayalaseema region of the state last year has been identified as Peanut Stem Necrosis Disease (PSND). The International Crops Research Institute for the Semi Arid Tropics (ICRISAT) has reportedly warned the state government that this deadly disease could affect all crops and is likely to recur.

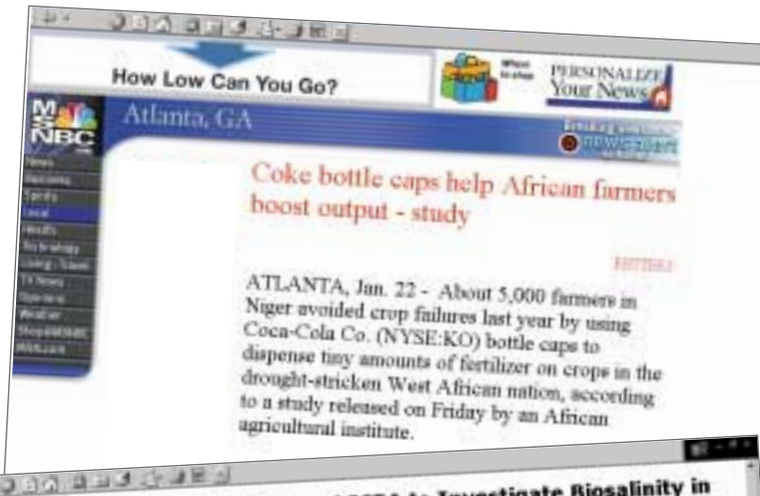
Thousands of acres of groundnut crop in Anantapur and other Rayalaseema districts of the state was affected last July-August with a virus that was initially identified as Bud Necrosis.

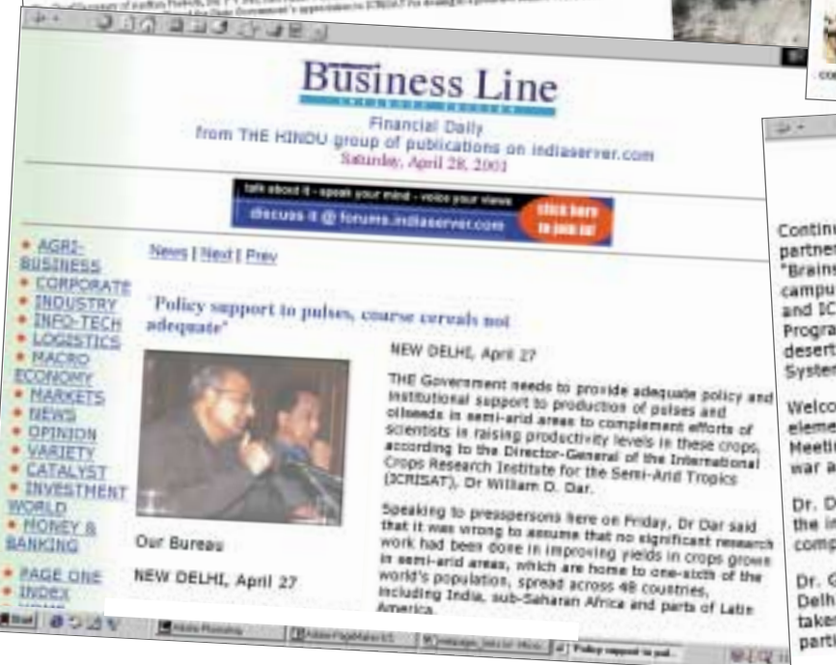
International Crops Research Institute for the Semi Arid Tropics officials who met Chief Minister N Chandrababu Naidu here on Thursday, explained to him about the deadly nature of the virus, which has spread to the sunflower crop bringing down the area under cultivation drastically. "Application of these technologies is providing useful information essential to develop broad-based durable PSND resistant groundnut genotypes and to understand the epidemiology of the PSND", officials told Naidu.

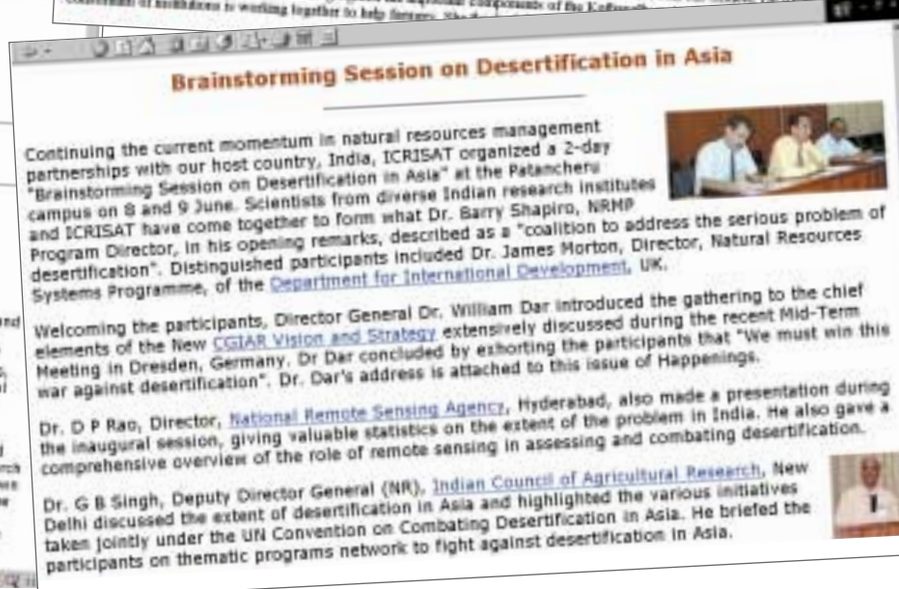
ఈనాడు హైదరాబాద్

ప్రపంచ బ్యాంకు ఉపాధ్యక్షుడు ఇయాన్ జాన్సన్ ముఖ్యమంత్రి చంద్రబాబునాయుడును సోమవారం ఆయన నివాసంలో కలిసి దృశ్యం

ICRISAT on the Web







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International Crops Research Institute for Semi-Arid Tropics (ICRISAT) Patancheru 502 324, Andhra Pradesh, India

Comments to Webmaster-ICRISAT. *Fair use of this material is encouraged. Proper citation is requested.*

SATrends
ICRISAT's monthly e-newsletter

To subscribe, send an e-mail to satrends-moderator@cgiar.org

SATrends Issue 3

S FROM THE SEMI-ARID TROPICS:

maka: Seeds Deliver Hope Amidst Chaos
e CGIAR Fights Desertification in Africa
eating the World's First Molecular Marker Map of Chickpea
ugeon and Cancer, Cracking a Hard Nut in Developing Countries

Celebrating this fruitful partnership, Dr. Long visited ICRISAT recently and presented Director
"Technologies to Achieve High Groundnut Yields in Vietnam", published by the Agriculture Publ
that Vietnamese scientists received at ICRISAT, where they "got good opportunities to learn abou
countries in the world and in the region", Dr. Long said.

In recognition of their contribution, two researchers from ICRISAT - Drs. C.L.L. Gowda (in 1997)
the Vietnamese Medal of Agriculture and Rural Development.

ICRISAT's contribution to work on groundnut in Vietnam began in 1990 under the 'Asian Grain Legu
United Nations Development Programme (UNDP), and the Food and Agriculture Organization (FAO)
funding to CLAN provided by the Asian Development Bank, and from ICRISAT.

For more information, please contact c.gowda@cgiar.org

Top

3. Pigeonpea Broadens Farmer's Options in Sudan

Sudan-ICRISAT partnership has identified a 'new' pulse crop
the poor. (Pulses are food grain legumes like lentils,

The early-maturing, high-
hectares of under
enriches

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Providing policy guidance, oversight, and counsel

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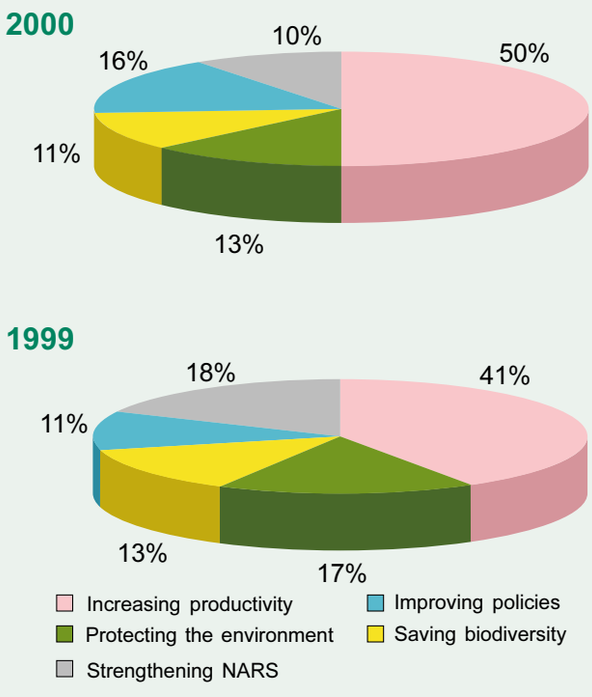
Financial Summary

Balance Sheet

US$ thousands

	2000	1999
Assets		
Cash and cash equivalents	19,408	23,510
Accounts receivable	5,121	4,356
Inventories	942	690
Prepaid expenses	400	256
Fixed assets – net	12,856	12,940
Other assets	425	505
Total	**39,152**	**41,257**
Liabilities		
Accounts payable	2,687	2,979
Accruals and Provisions	1,153	1,059
Payments in advance from donors	3,433	6,693
In-trust funds	79	85
Long-term liabilities	6,202	6,572
Total	**13,554**	**17,388**
Net Assets		
Unrestricted	20,033	19,179
Restricted	5,565	5,690
Total	**25,598**	**24,869**

Expenditures by CGIAR Activity

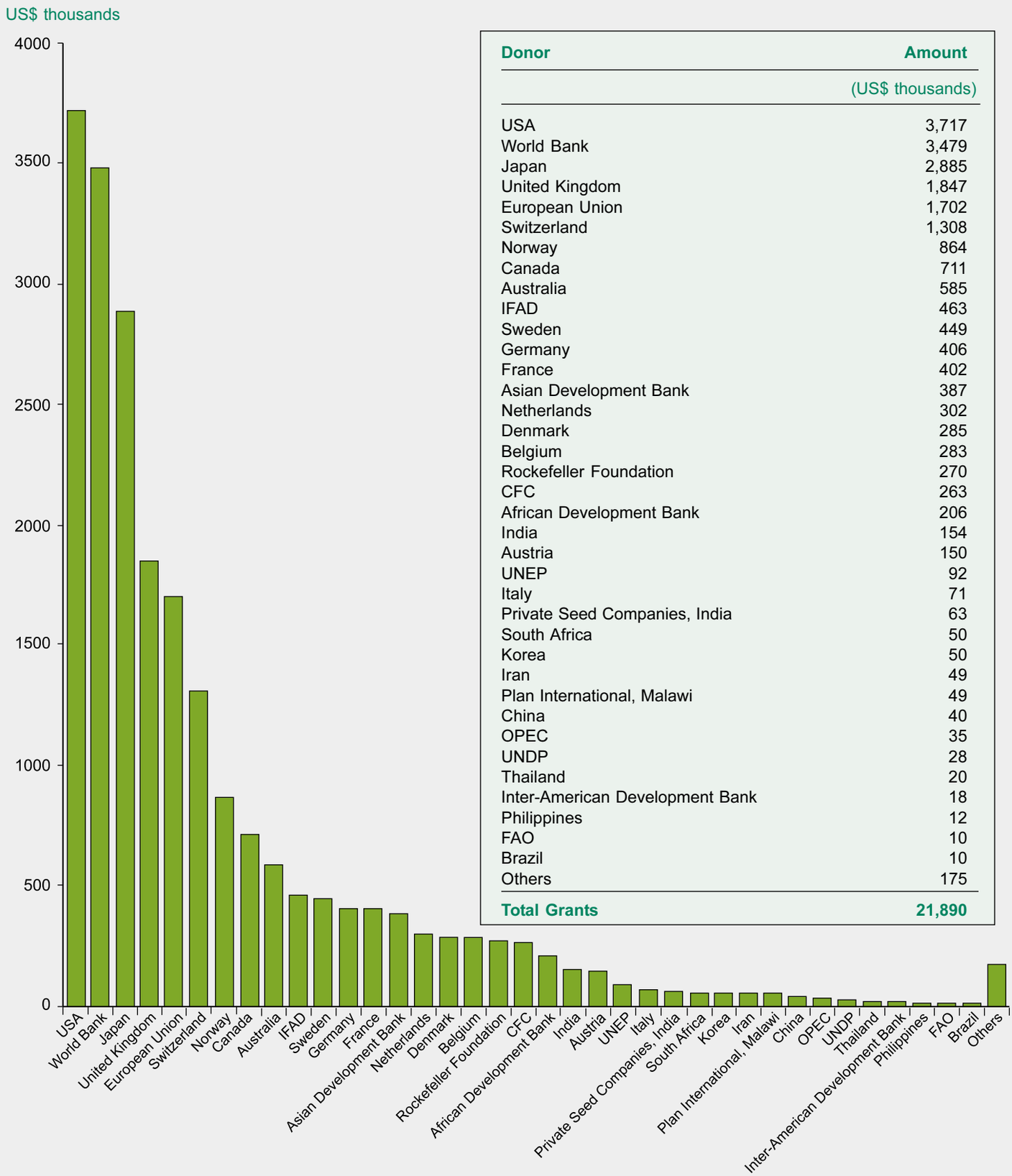


Operating Results and Movements in Net Assets

(US$ thousands)

	2000	1999
Operating results		
Revenue	23,431	22,402
Expenditure	23,276	23,002
Surplus/(deficit) before extraordinary items	155	(600)
Extraordinary items	761	(256)
Operating surplus/(deficit)	**916**	**(856)**
Net Assets – Unrestricted		
Opening balance	19,179	48,016
Surplus/(deficit) for the year	916	(856)
Asset Acquisition – Restricted grants, net	89	79
Fixed Assets deleted	–	(27,862)
Loss on Sale of Fixed Assets	–	(66)
Additions to physical facilities	(99)	(66)
Housing Loans, net interest earned	(26)	(46)
Prior Year Charges	(26)	(20)
Closing balance	**20,033**	**19,179**
Net Assets – Restricted		
Opening balance	5,690	5,705
Deletion, net Additions	(125)	(15)
Closing balance	5,565	5,690
Net Assets – Total	**25,598**	**24,869**

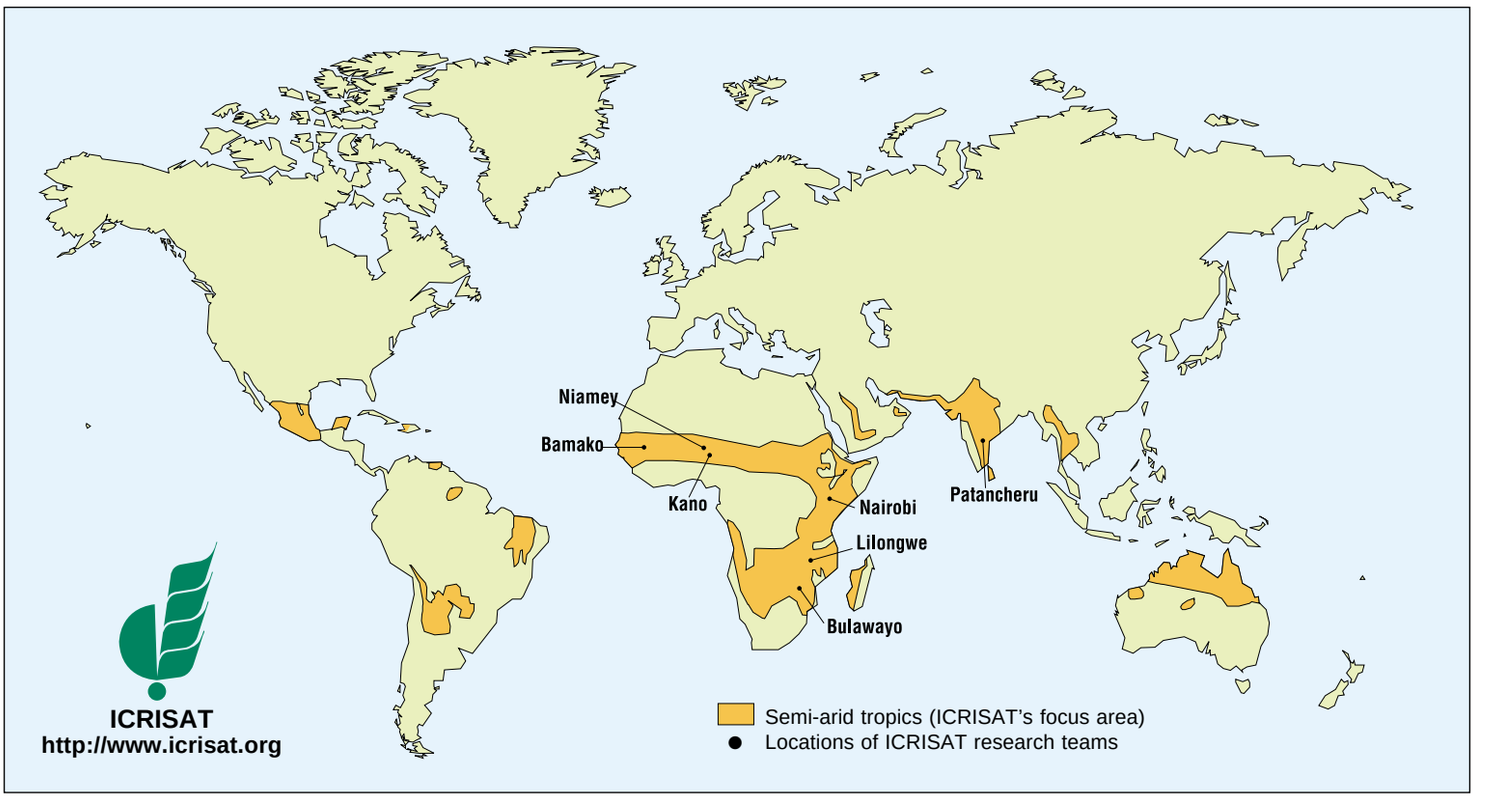
Grant Income from Donors for the year 2000



Donor	Amount (US$ thousands)
USA	3,717
World Bank	3,479
Japan	2,885
United Kingdom	1,847
European Union	1,702
Switzerland	1,308
Norway	864
Canada	711
Australia	585
IFAD	463
Sweden	449
Germany	406
France	402
Asian Development Bank	387
Netherlands	302
Denmark	285
Belgium	283
Rockefeller Foundation	270
CFC	263
African Development Bank	206
India	154
Austria	150
UNEP	92
Italy	71
Private Seed Companies, India	63
South Africa	50
Korea	50
Iran	49
Plan International, Malawi	49
China	40
OPEC	35
UNDP	28
Thailand	20
Inter-American Development Bank	18
Philippines	12
FAO	10
Brazil	10
Others	175
Total Grants	**21,890**

Acronyms

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank (Philippines)
AME	Agriculture, Man, Ecology (India)
ANGRAU	Acharya N G Ranga Agricultural University (India)
APSIM	Agricultural Production Systems Simulator (Australia)
BAIF	Bhartiya Agro-Industries Foundation (India)
BARI	Bangladesh Agricultural Research Institute
BBF	broadbed-and-furrow
BGM	Botrytis Grey Mold
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklng (Germany)
Bt	*Bacillus thuringiensis*
CAZRI	Central Arid Zone Research Institute (India)
CCER	Center Commissioned External Review (CGIAR)
CCSHAU	Chaudhary Charan Singh Haryana Agricultural University (India)
CENARGEN	Centro Nacional de Pesquisa de Recursos Genéticos e Biotecnología (Brazil)
CESS	Centre for Economic and Social Studies (India)
CFC	Common Fund for Commodities (Netherlands)
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement (France)
CLAN	Cereals and Legumes Asia Network (ICRISAT)
CORAF	Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles
CORD	Centre for Overseas Research and Development (UK)
CRIDA	Central Research Institute for Dryland Agriculture (India)
CRSP	Collaborative Research Support Program (USA)
DFID	Department for International Development (UK)
DGIC	Directorate General for International Cooperation (Belgium)
DMP	Desert Margins Program
DPAP	Drought-Prone Area Project (India)
ELISA	enzyme-linked immunosorbent assay
FAO	Food and Agriculture Organization of the United Nations (Italy)
GEF	Global Environment Facility
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (Germany)
HNPV	Helicoverpa Nuclear Polyhedrosis Virus
IBSRAM	International Board for Soil Research and Management (Thailand)
ICAR	Indian Council of Agricultural Research
ICPA	Indian Crop Protection Association
IDRC	International Development Research Centre (Canada)
IER	Institut d'économie rurale (Mali)
IFAD	International Fund for Agricultural Development (Italy)
IFDC	International Fertilizer Development Center (USA)
IISS	Indian Institute of Soil Science
INERA	Institut d'études et de recherches agricoles (Burkina Faso)
INIFAP	Instituto Nacional de Investigaciones Forestales y Agropecuarias (Mexico)
INRAB	Institut national de recherche agronomique du Bénin
INRAN	Institut national de recherches agronomiques du Niger
INTSORMIL	USAID Title XII International Sorghum/Millet Collaborative Research Support Program (USA)
IPALAC	International Program for Arid Land Crops (Israel)
IPM	integrated pest management
ISRA	Institut sénégalais de recherches agricoles
JNKVV	Jawaharlal Nehru Krishi Vishwa Vidyalaya (India)
KARI	Kenya Agricultural Research Institute
KKU	Khon Kaen University (Thailand)
MAU	Marathwada Agricultural University (India)
MVF	Mamidipudi Venkatarangaiah Foundation (India)
NAARM	National Academy of Agricultural Research Management (India)
NARS	national agricultural research system(s)
NBPGR	National Bureau of Plant Genetic Resources (India)
NBSS&LUP	National Bureau of Soil Survey and Land Use Planning (India)
NCIPM	National Centre for Integrated Pest Management (India)
NPV	Nuclear Polyhedrosis Virus
NRCG	National Research Centre for Groundnut (India)
NRI	Natural Resources Institute (UK)
NRMP	Natural Resource Management Program (ICRISAT)
NRSA	National Remote Sensing Agency (India)
OPEC	Organisation of Petroleum Exporting Countries (Austria)
PROVA	People's Resource Oriented Voluntary Association (Bangladesh)
PSND	Peanut Stem Necrosis Disease
RFLP	restriction fragment length polymorphism
ROCAFREMI	Réseau ouest et centre africain de recherche sur le mil (WCAMRN, Niger)
ROCARS	Réseau ouest et centre africain de recherche sur le sorgho (WCASRN, Mali)
SADC	Southern African Development Community (Botswana)
SAU	State Agricultural University
SCRI	Scottish Crop Research Institute (UK)
SG 2000	Sasakawa-Global 2000 (Japan)
SLP	Systemwide Livestock Project (CGIAR)
SMINET	Sorghum and Millet Improvement Network
SMIP	Sorghum and Millet Improvement Program (Zimbabwe)
STAAD	Society for Transformation, Agriculture and Alternatives in Development
STMS	sequence tagged microsatellite site
TSV	Tobacco Streak Virus
UCL	Université Catholique de Louvain (Belgium)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
VASI	Vietnam Agricultural Science Institute
VUB	Vrije Universiteit Brussel (Belgium)
WCASRN	West and Central Africa Sorghum Research Network (ROCARS, Mali)



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What is ICRISAT ?

A nonprofit, apolitical, international organization for science-based agricultural development. Established in 1972, it is one of 16 Centers supported by more than 50 donor governments, foundations, and development banks, through membership in the Consultative Group for International Agricultural Research (CGIAR). ICRISAT has approximately 1200 staff, and an annual expenditure of about US$ 22 million in 2000.

ICRISAT's mission and focus

To help developing countries apply science to increase crop productivity and food security, reduce poverty, and protect the environment. ICRISAT focuses on the farming systems of the semi-arid (dry) tropical areas of the developing world. Special emphasis is placed on five crops that are particularly important in the diets of the poor: sorghum, millet, groundnut, chickpea, and pigeonpea.

ICRISAT's strategy

To form research partnerships with government, nongovernmental, and private sector organizations in developing countries, and to link these partners to advanced research institutions worldwide. Each partner contributes its unique strengths to make the whole greater than the sum of its parts. ICRISAT excels in strategic research on global issues, and on international exchanges of knowledge, technologies, and skills. These products and services help partners enhance their capabilities to meet regional, national, and local development needs.

Where is ICRISAT ?

Staff are based at seven locations across Africa and Asia, shown above. From these points, they travel extensively to work with partners across the semi-arid tropical world.

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