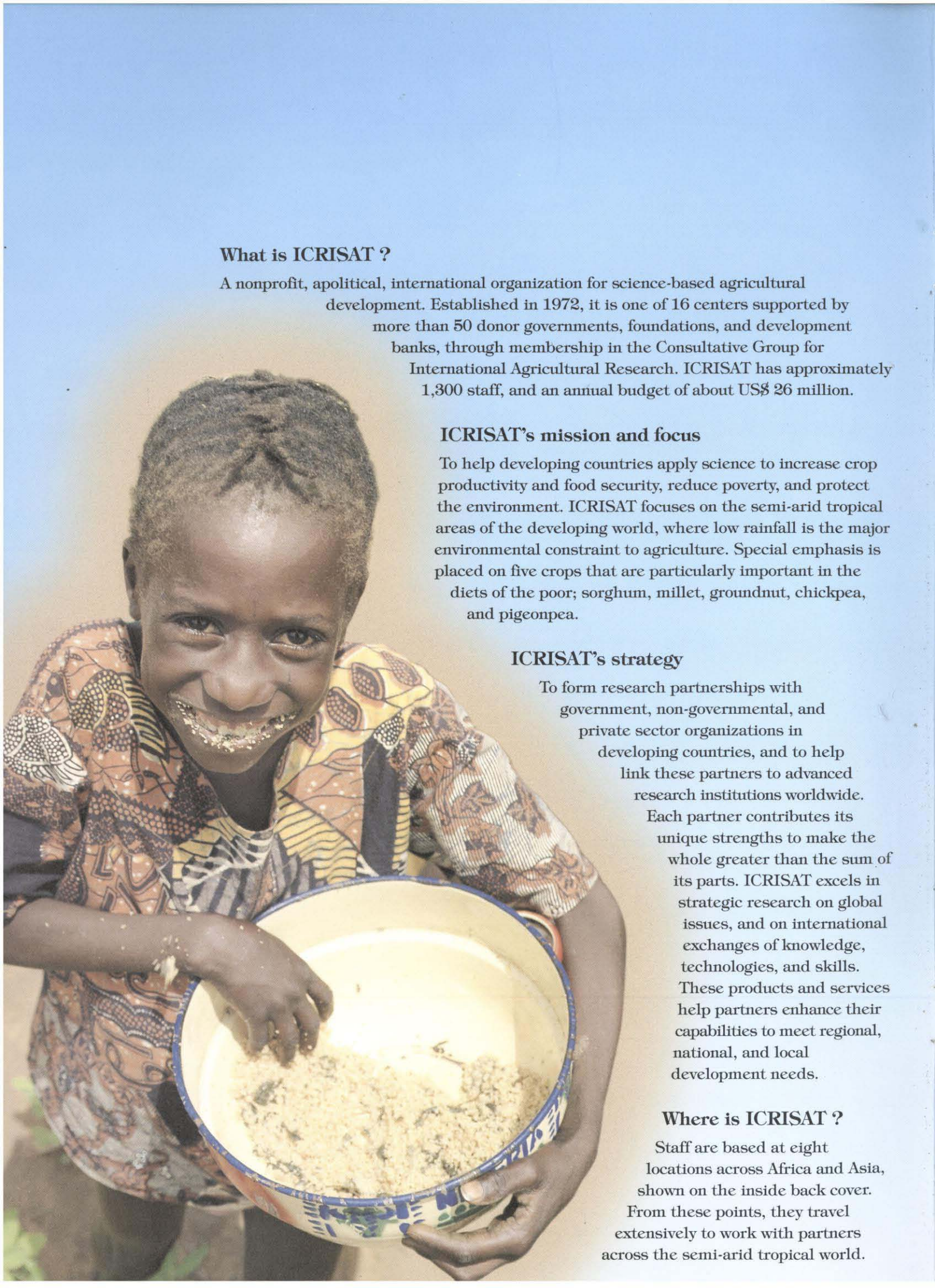
ICRISAT

Partnerships in Research for Development

April 1998



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. ICRISAT has approximately 1,300 staff, and an annual budget of about US$ 26 million.

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 semi-arid tropical areas of the developing world, where low rainfall is the major environmental constraint to agriculture. 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, non-governmental, and private sector organizations in developing countries, and to help 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 eight locations across Africa and Asia, shown on the inside back cover. From these points, they travel extensively to work with partners across the semi-arid tropical world.

Partnerships in Research for Development

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ICRISAT

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

1998

SOME SAY THEY SHOULDN'T EVEN BE THERE.

Scratching out a living from the parched sands and rubble along the world's tropical desert margins doesn't conjure up optimistic visions in the minds of many. But the persistent peoples of the semi-arid tropics have a long and proud history. They have forged cultures, traditions, and remarkably adept technologies for survival that have amazed and enriched the world.

And if they were to leave, where would they go?

Into refugee camps, urban slums, or an exodus to the developed countries? The populations of these areas now number some 850 million, or one-sixth of humanity — half of whom subsist on less than a dollar a day.

Yet their world is changing rapidly.

For millennia, the dry tropics have been the sparsely settled domains of nomadic peoples, but over the past century these regions have become more densely occupied due to such complex developments as the establishment of national borders and property restrictions, population growth, and town expansion. The pressure on land is accelerating at an unprecedented rate, while these peoples have alarmingly few resources to deal with the blistering pace of change. All too often, the rush of "progress" has erupted into war and famine, as in Angola, Ethiopia, Somalia, and Sudan in recent years.

Clearly, the world must help –

and that realization gave birth to ICRISAT.

Agriculture is the livelihood of the semi-arid tropics, employing more than half of its people- with the highest proportions in the poorest areas. This is why agricultural development benefits the poorest people most directly. ICRISAT's focus is on crops that the poor grow, further ensuring that the contributions of development investors benefit the most disadvantaged in today's society.

Those benefits have been impressive.

Careful impact assessment studies have shown that more productive crop varieties derived from breeding research carried out by ICRISAT in partnership with national scientists are generating benefits worth more than ten times ICRISAT's annual budget. The pace of impact is increasing, as a quarter-century of consistent investment has helped to build a critical mass of technologies and national capacities that is now paying off.

The benefits reach millions of poor households in immediate forms: better family nutrition, more cash for children's education, extra income to reinvest in developing the farm enterprise, and lower food prices for consumers. By stabilizing their economic base, the rural poor gain control of their own futures- restoring their pride and commitment to peaceful development – and reducing the risk of nightmare scenarios of catastrophic suffering and mass exodus from the land, scenes that have been all too frequent in the past.

And these direct payoffs are in addition to the benefits gained from increased scientific knowledge and talent, networks of mutual collaboration and support, and international confidence building. Such intangibles are immensely important to a future of peace and prosperity for all.

ICRISAT is one of sixteen nonprofit international centers dedicated to providing the world's development investors with an avenue for helping the poor through enhanced agricultural productivity. Sometimes called "the fragile web", these centers form threads of partnership with a wide array of national, regional, public and private, governmental and non-governmental organizations, all committed to work together for the common cause of sustainable development. Linked under a consortium of development investors known as the Consultative Group on International Agricultural Research (CGIAR), the goal of the centers is to advance five major undertakings: increasing agricultural productivity, protecting the environment, saving biodiversity, improving policies, and strengthening national research programs in developing countries.

This report provides a glimpse of some of the most exciting partnerships in which ICRISAT is currently involved, highlighting their contributions to those five undertakings. We hope it provides an insight to the scope of our agenda, the vigor of our partnerships, and the creativity and potential impacts of our science. We trust this brief synopsis illustrates our effectiveness as a contributor to the goal of peaceful development, for less than the cost of a single modern warplane each year.

We invite you to learn more about ICRISAT, and encourage you to consider joining our fragile web of partnerships in research for the development of both peoples and agriculture in the semi-arid tropics. Our addresses are inside the back cover. Our new world-wide web page is an especially rich source of information (http://www.cgiar.org/icrisat).

Shawki M Barghouti
Director General

Ragnhild Sohlberg
Governing Board
In-coming Chair

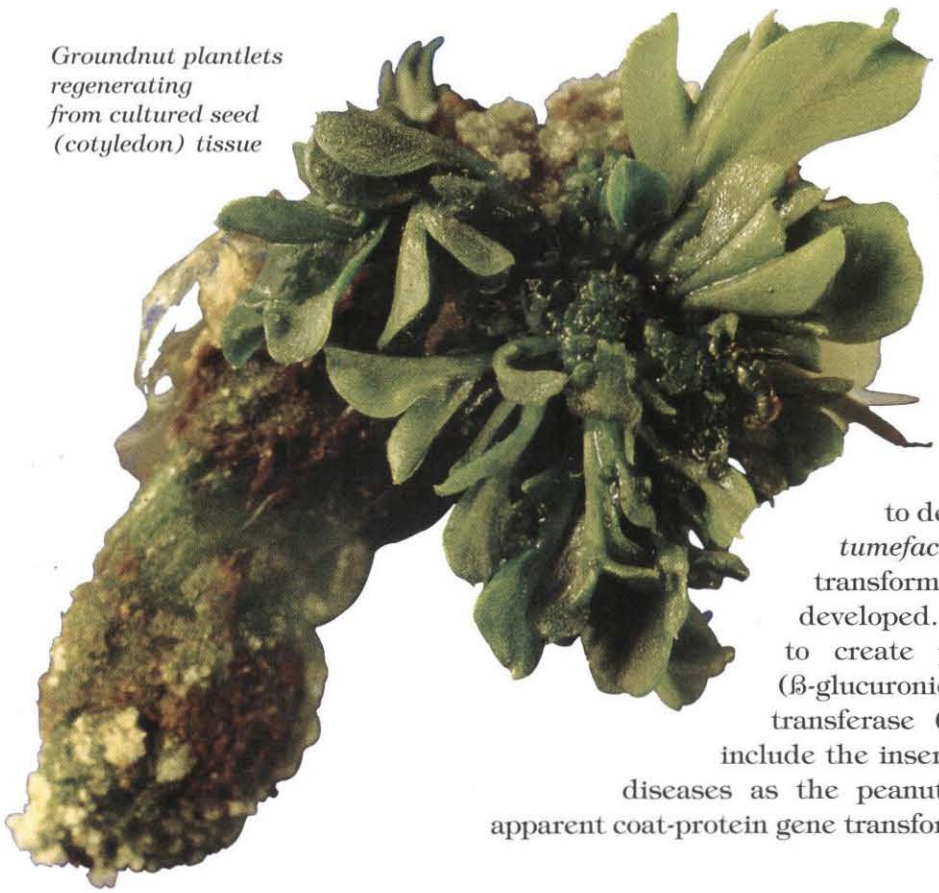
R S Paroda
Governing Board Chair

INCREASING

Higher returns to labor, land, and purchased inputs help farmers escape the poverty trap, lower costs for consumers, and grow more food for ever-increasing populations.

Keeping downy mildew in line. Following the path that led to the 1996 King Baudouin Award, the CGIAR's highest accolade, advanced institutes in the UK together with ICRISAT have achieved their first product of molecular marker-assisted selection that is likely to have large field impact. In a process that shaved years off the time required for a conventional breeding solution, quantitative trait loci (QTL) for resistance to the downy mildew fungus have been backcrossed into an elite line that is a parent to pearl millet hybrids grown on over one million hectares in India. The importance of this achievement goes beyond the stabilization of global pearl millet production; by extending the useful life of the line, it adds enormous value to past investments in both national and international breeding research.

Groundnut in Vietnam: the fruits of partnership. Dr Phan Lieu, Director of the Oil Plant Institute of Vietnam (OPI), reports that the groundnut production technology package jointly developed by ICRISAT and the Vietnamese national agricultural research system (NARS) has stimulated an increase of 49% in the area sown to the crop since 1990, and a 21% increase in average yield. The package consists of land preparation (using broadbeds and furrows), high-yielding varieties (e.g., VD 1), appropriate fertilizers, nitrogen-boosting *Rhizobium* inoculation, control of weeds, pests, and diseases, and irrigation. Another significant output of the partnership is a coconut ash substitute. Vietnamese farmers use coconut ash (1.5–2 t ha^{-1}) to provide valuable mineral nutrients to the crop. When coconut ash became scarce and expensive, groundnut production declined. Dr Lieu says, "Scientists from OPI analyzed it, and developed a chemical substitute called Alternative Coconut Ash — an ingenious combination of nitrogen, lime, borax, phosphorus, and potash, that is now being produced commercially in Vietnam."



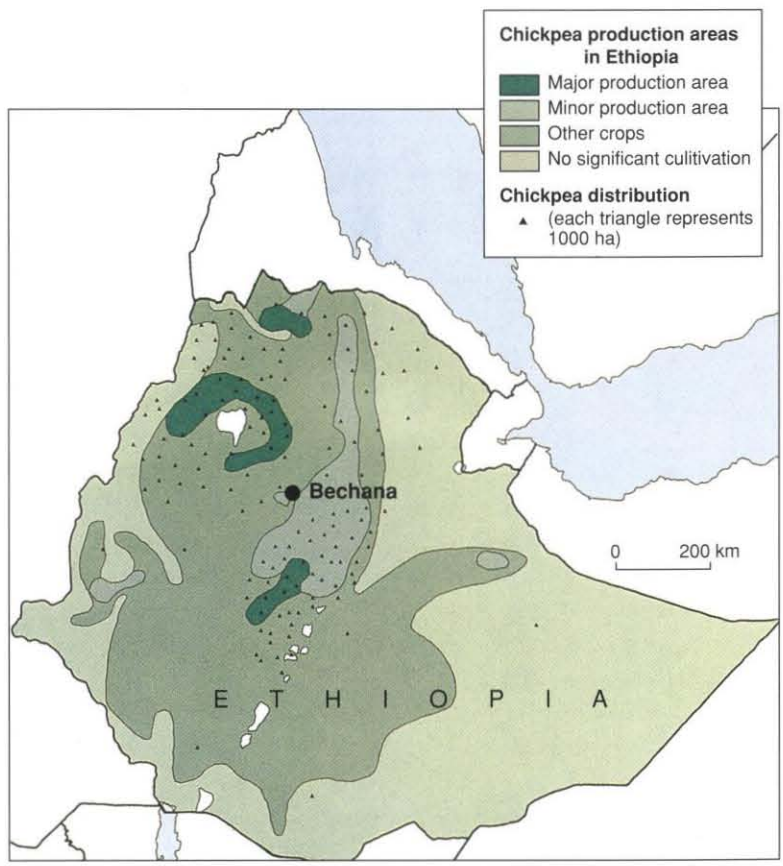
Groundnut plantlets regenerating from cultured seed (cotyledon) tissue

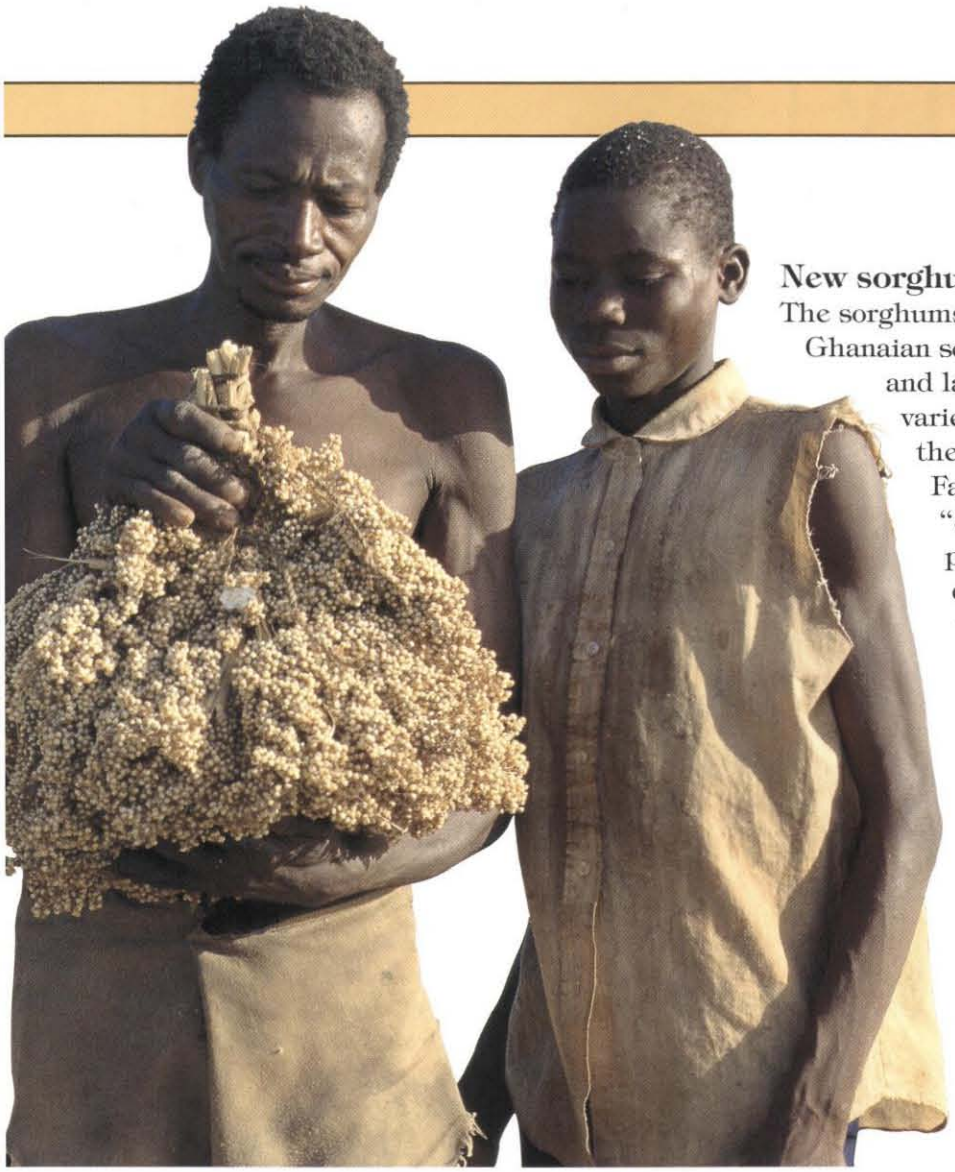
Transforming the groundnut crop.

Genetic transformation is a technique that promises to break old barriers to higher productivity for the food crops of the poor. However, the technical difficulties of transferring microscopic DNA fragments into cultured plant tissue, and regenerating plants from those cells, must first be overcome. ICRISAT is making good progress in vaulting these technical hurdles for the groundnut crop. By culturing mature seeds of spanish type varieties, manipulating the culture media constituents and tissues, and using a special bacterium to invade the cultures to deliver new DNA material (*Agrobacterium tumefaciens*-based binary vectors), an efficient transformation and regeneration system has been developed. To date, this system has been able to create plants transformed with test genes (ß-glucuronidase (GUS) and neomycin phospho-transferase (NPT II). Practical applications will include the insertion of genes for resistance to such key diseases as the peanut clump virus — for which over 100 apparent coat-protein gene transformants have already been produced.

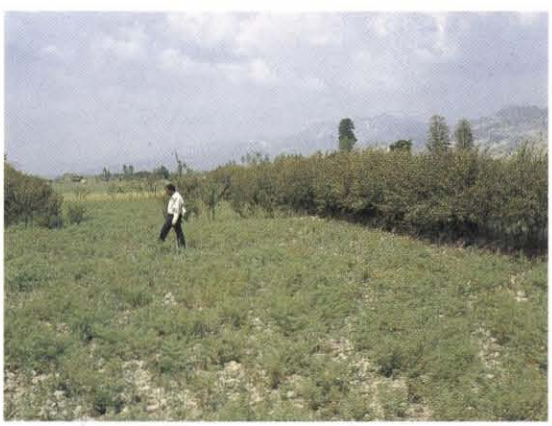
From hand to hand: farmers share a chickpea variety in Ethiopia.

Farmers — like most consumers — are wary of new products. But in Bechana, Ethiopia, they have not only adopted Mariye, a high-yielding chickpea variety identified from ICRISAT breeding material, but have actively promoted its cultivation by sharing seeds from one farm to the next. Almost the entire chickpea area in Bechana is now sown to Mariye. Furthering the partnership, ICRISAT is helping Ethiopian scientists carry out an impact assessment study on the variety. The long-standing collaboration on chickpea has additional dimensions — during 1997, ICRISAT sent targeted drought-resistant material to meet Ethiopian requests, and invited a national agronomist to participate in the Global Grain Legumes Drought Resistance Network meeting.

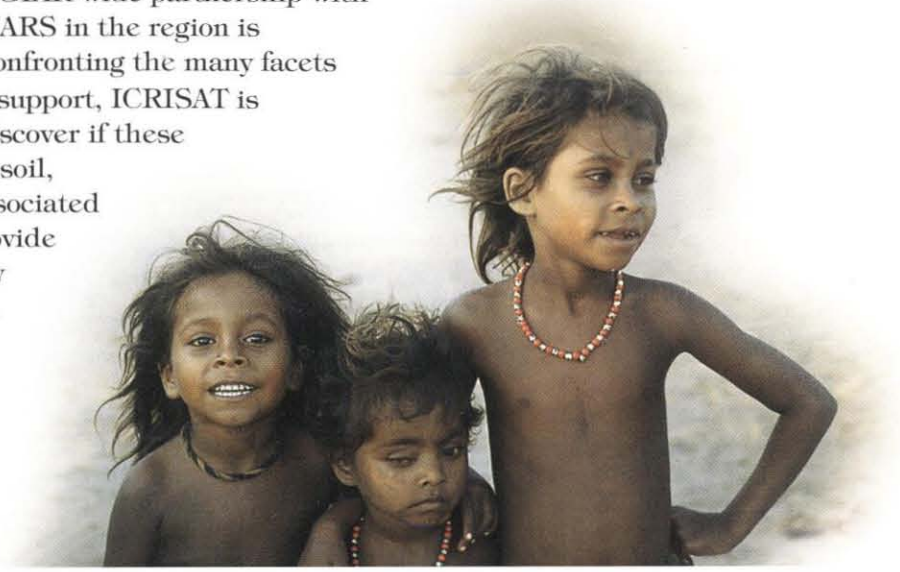




New sorghums a hit with Ghanaian farmers. The sorghums ICSV 111 IN and Framida, identified by Ghanaian scientists from ICRISAT breeding material and landrace collections, have been released as varieties and are rapidly becoming popular there, according to a recent joint survey. Farmers appreciate Framida (locally called "Sasakawa", in honor of the Japanese philanthropist who sponsored the development initiative that disseminated the variety) for its wide adaptability to the semi-arid tropics, its tolerance to *Striga*, and its superior brewing qualities. "Kapaala", as ICSV 111 IN is locally known, has many advantages including its short duration (that allows it to escape drought and fit into different cropping systems), high yield, and good food and brewing qualities. The Savanna Agricultural Research Institute (SARI) of Ghana has highlighted Kapaala as a priority sorghum technology for dissemination. Much informal seed exchange is taking place among farmers, but the demand is so high that such NGOs as ActionAid are requesting SARI to multiply extra volumes of seed.



Stepping in between: legumes to sustain and diversify rice-wheat systems. The vast Indo-Gangetic Plain, drainage basin of the legendary Indus and Ganges rivers, covers a swath of rich farmland spanning four countries in south Asia, and is home to some 260 million of the world's poorest people — equal to the entire population of the USA. The site of major Green Revolution success stories for rice and wheat, this critical agro-ecosystem is now showing alarming signs of instability: water tables are receding, and yields of rice and wheat have plateaued or are declining, despite the availability of new technologies. The reasons are complex, and a CGIAR-wide partnership with NARS in the region is confronting the many facets of the problem. With Asian Development Bank support, ICRISAT is contributing its expertise on legumes to help discover if these nitrogen-fixing species can help break negative soil, nutrient, water use, and pest buildup trends associated with continuous cereals cultivation, and can provide cropping diversification to stabilize productivity and farm incomes. One promising development has been the identification of an extra-short duration pigeonpea variety (ICPL 88039) that uses less water than rice (since it requires no irrigation), and can be fitted into rotations between cereal crops.

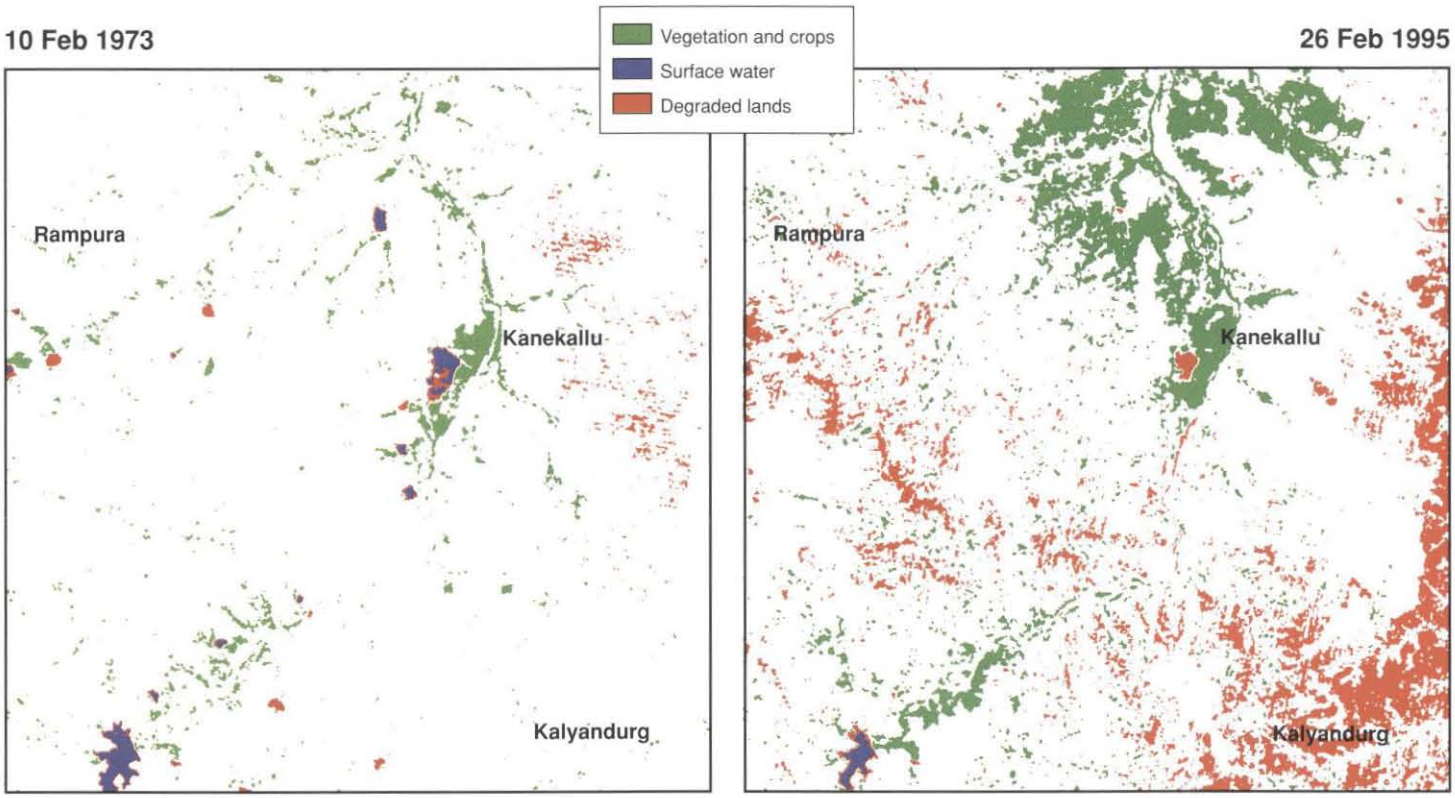


A new game plan against Striga in sorghum. *Striga* is a parasitic weed that taps into the roots of sorghum, denying it water and nutrients, and reducing yields by 15–80%. It is most widespread and particularly damaging to the crops of poor farmers across Africa, who lack the resources to provide compensatory nutrients or use control methods. Decades of resistance breeding research have made limited progress against this "witchweed", because many genes of small individual effect are involved, and such genes are difficult to track through generations. The new tools of molecular genetics may provide the answer. ICRISAT and scientists from the University of Hohenheim and Eberhard-Karls University of Tübingen in Germany are attempting to find molecular markers capable of tracking the quantitative trait loci involved. Markers could then be used as tags to help breeders know which lines to cross and select so that their offspring contain the highest numbers of resistance genes. Field tests have been promising, and analysis of the molecular data is in progress.

Maruca meets its match. Pigeonpeas are tasty not only to people, but also to insect pests. Pod borers cause huge annual losses, especially to the poorest farmers who cannot afford pesticidal control. ICRISAT entomologists are searching for genetic mechanisms that might help the plant defend itself against these attackers, in particular the pod borer *Maruca vitrata*. Several factors appear promising, including the insect's aversion to laying eggs on pods with certain characteristics; discouraging taste factors; and anti-nutritional compounds that impede insect reproduction and growth. The search is aided by an immensely valuable tool – the world's pigeonpea germplasm collection held at ICRISAT's Patancheru facility. This repository of genetic diversity has been screened against *Maruca*, and lines have been identified that are resistant not only to *Maruca* but also to other important pests.

PROTECTING

Agriculture is the world's major user of land, water, and biological resources – so sustainable farming systems are not only crucial for ensuring the world's future food supply, but also the quality of the global environment.



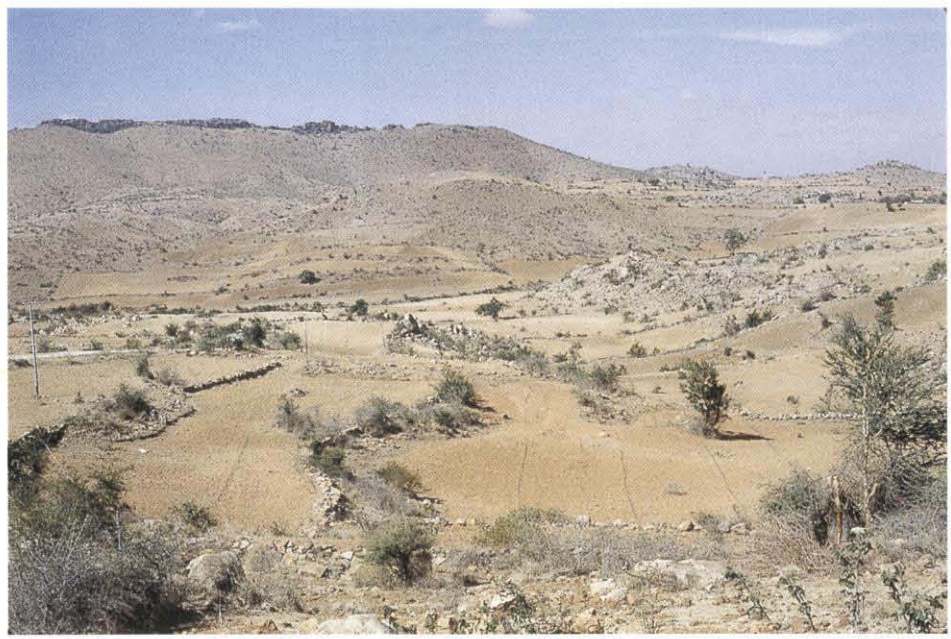
Satellite images of Anantapur district, Andhra Pradesh, India

The silent threat of soil and water degradation.

One of the most challenging tasks in combating environmental degradation is simply being able to identify and recognize the problem. Changes in soils, water, and vegetation in semi-arid areas occur slowly but over massive areas, and are often not noticed until it is too late, by which time they have become irreversible. To meet this challenge, the Japan International Research Center for Agricultural Sciences has provided support including scientific staff working with Indian and ICRISAT scientists on the use of satellite images, supplemented by "ground-truthing" farm surveys, to quantify changes over large areas. This approach is proving to be accurate and powerful. Satellite images of Anantapur district in southern India show a substantial increase in cropping intensity between 1973 and 1995. But during the same period, the area of land affected by wind-blown sand, alkalinity, and salinity has increased by nearly ten times, while the surface area of water in irrigation tanks and natural ponds has shrunk by one third. These studies will serve as an invaluable database for remedial efforts.

THE ENVIRONMENT

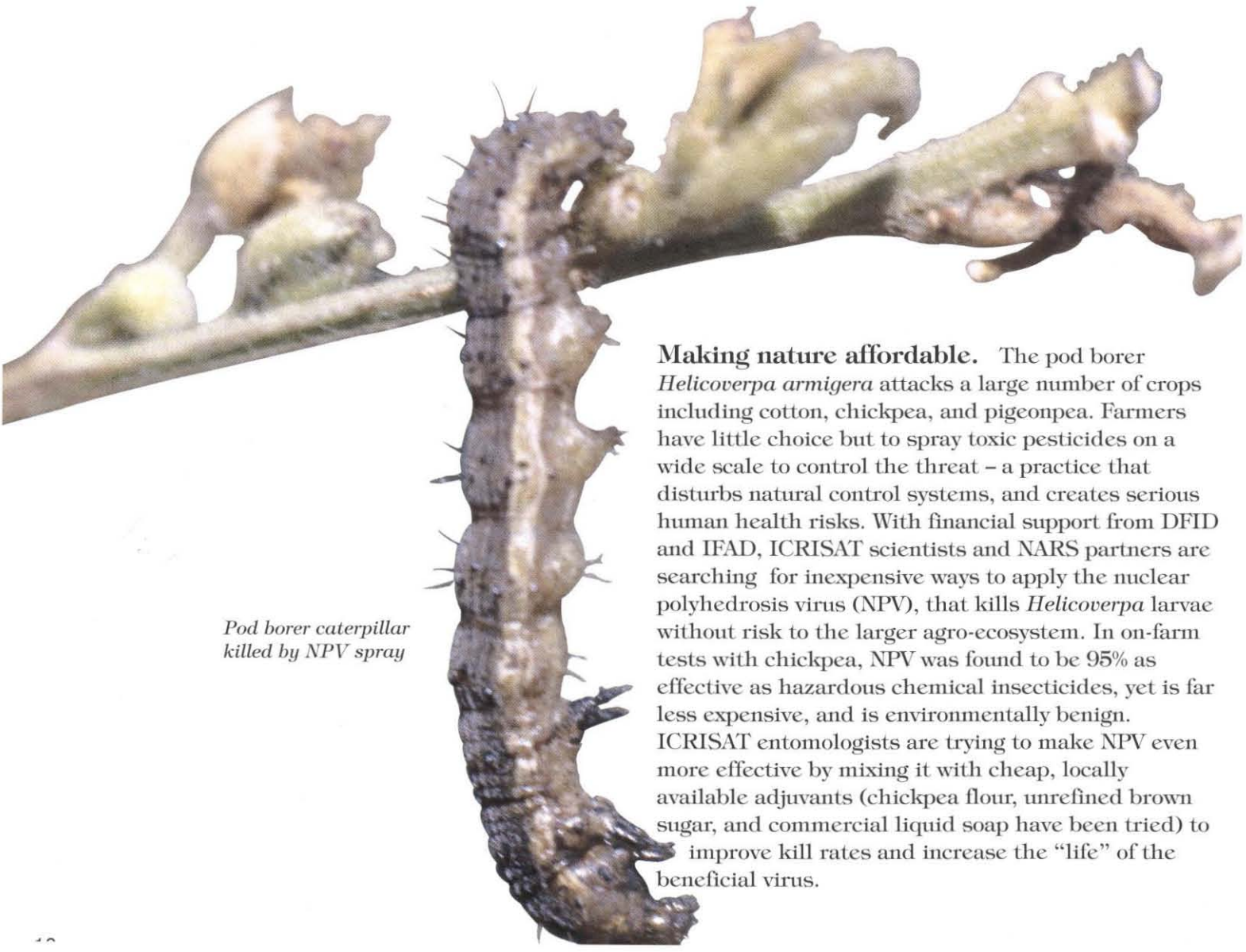
A watershed in sustainable development. Watersheds are strategic land units, and the target for an increasing number of development initiatives. ICRISAT is partnering local institutions to develop methodological principles that can be applied globally, and strengthen the scientific input into these projects. During 1997, ICRISAT joined hands with the Deccan Development Society (DDS) and the National Remote Sensing Agency (NRSA) of India in the development of a 475 hectare watershed in Zaheerabad district, Andhra Pradesh. DDS is the catalyst, identifying target areas and mobilizing community labor to plug gullies, build bunds, and establish check dams. NRSA provides remote sensing data and satellite-generated maps, which ICRISAT scientists have compiled into geo-referenced maps. ICRISAT also lends its expertise in soil/water analysis, and the measurement of degradation processes.



The acid reality. With some 50 million hectares already sown to pastureland and a few crops, the acid-soil savannas of equatorial South America have enormous potential to relieve agricultural pressures now threatening the fragile Amazon forests. However, few cropping options are available to exploit this opportunity, because the savannas' acidic soils are burdened with a complex of interrelated constraints: high aluminium toxicity, low contents of vital nutrients, and sandy textures that are highly prone to drought (even though rainfall is high, little is retained in the root zone). Sorghum and millet can tolerate these soil stresses far better than most other crops — but would need to be bred to resist diseases associated with the humid climate of the region. In partnership with CIAT and the national programs of Bolivia, Brazil, Colombia, Peru, and Venezuela, and through support from the Inter-American Development Bank, ICRISAT scientists have tested over 1,300 breeding lines in this difficult environment — and found a number that are tolerant of both soil acidity and leaf diseases. These lines are being shared with NARS throughout the region.

Aluminium toxicity symptoms in a susceptible sorghum line

Detecting danger in foodstuffs. Andhra Pradesh, India, 1994: over 200,000 chickens die after eating feeds contaminated by aflatoxins — potent, carcinogenic, immuno-suppressive biochemicals produced when the *Aspergillus* fungus invades such agricultural commodities as maize, chillies, turmeric, and groundnut. Most developing countries have limited or, as in India, no aflatoxin monitoring kits. And even if they are available, commercial kits are prohibitively expensive at US$ 12 per sample tested. Scientists at ICRISAT are developing far cheaper immunological methods to detect and estimate aflatoxins. In pilot studies, polyclonal antibodies have already been produced — a first step in designing practical kits that could be used by NARS, NGOs, food quality professionals, and health administrators to ensure safer foods and feeds. Following these promising results, the UK's Department for International Development (DFID) recently committed support for partnership with the Scottish Crop Research Institute to enable the project to move forward.

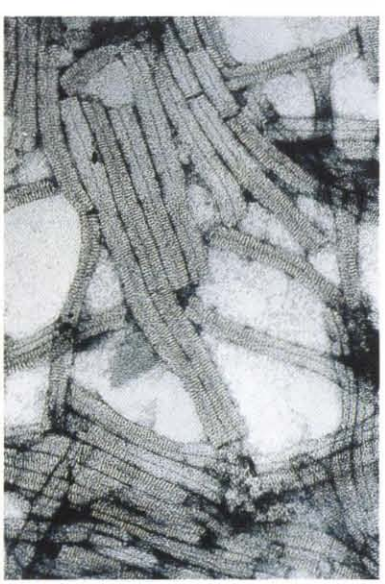


Pod borer caterpillar killed by NPV spray

Making nature affordable. The pod borer *Helicoverpa armigera* attacks a large number of crops including cotton, chickpea, and pigeonpea. Farmers have little choice but to spray toxic pesticides on a wide scale to control the threat – a practice that disturbs natural control systems, and creates serious human health risks. With financial support from DFID and IFAD, ICRISAT scientists and NARS partners are searching for inexpensive ways to apply the nuclear polyhedrosis virus (NPV), that kills *Helicoverpa* larvae without risk to the larger agro-ecosystem. In on-farm tests with chickpea, NPV was found to be 95% as effective as hazardous chemical insecticides, yet is far less expensive, and is environmentally benign. ICRISAT entomologists are trying to make NPV even more effective by mixing it with cheap, locally available adjuvants (chickpea flour, unrefined brown sugar, and commercial liquid soap have been tried) to improve kill rates and increase the "life" of the beneficial virus.

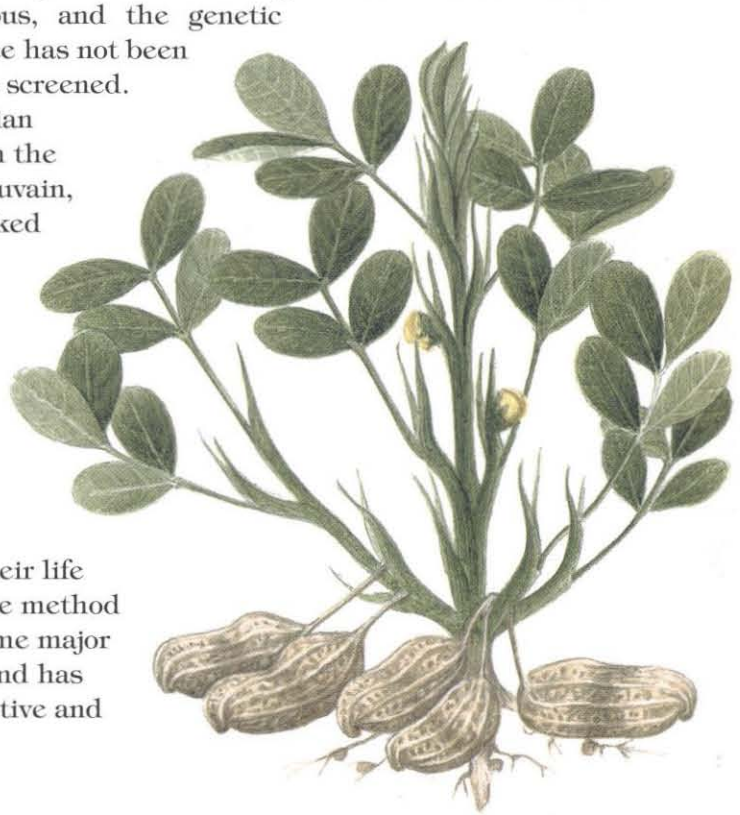
Groundnut crop weakened by the peanut clump virus

Outfoxing the peanut clump virus. Working stealthily underground, the peanut clump virus causes one of the most destructive diseases of the crop, with annual losses estimated at US$ 40 million worldwide. The fungus *Polymyxa* carries the virus from cereal hosts to other plant species, including both cereals and legumes, thus circumventing the protective barrier provided by traditional crop rotation. Toxic agrochemicals to control the fungus are too expensive and hazardous, and the genetic approach has also disappointed: resistance has not been found in more than 9,000 groundnut lines screened.



Electron micrograph of peanut clump virus particles

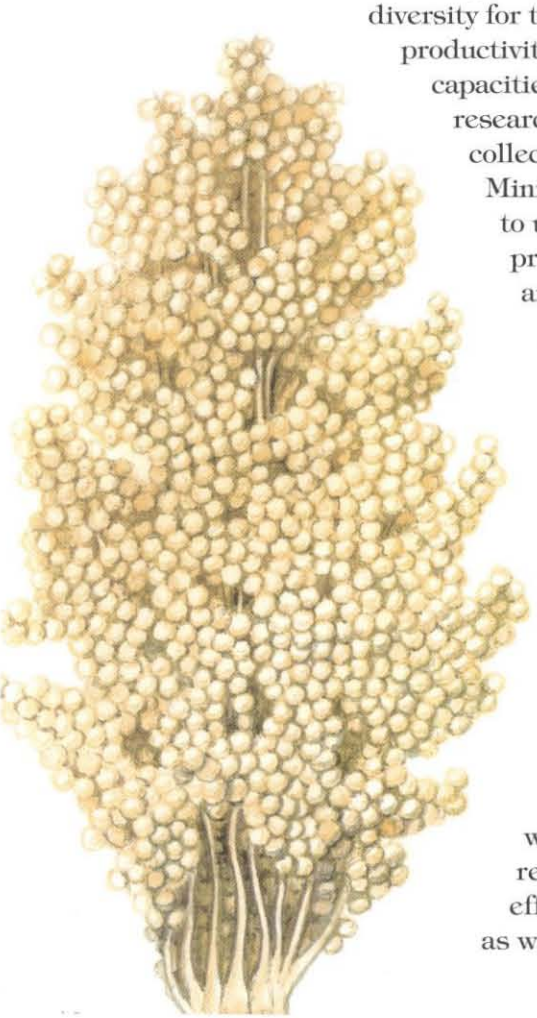
With support from the Belgian Government, scientists from the Université catholique de Louvain, Louvain-la-Neuve, have worked with ICRISAT to develop a simple, environmentally friendly clump control strategy. Before sowing groundnut, a millet crop is sown to "trap" *Polymyxa* in its developmental stage, and then plowed in to kill both the fungus and virus before they can complete their life cycle. The practicality of the method has been investigated in some major production areas of India, and has been shown to be both effective and economical.



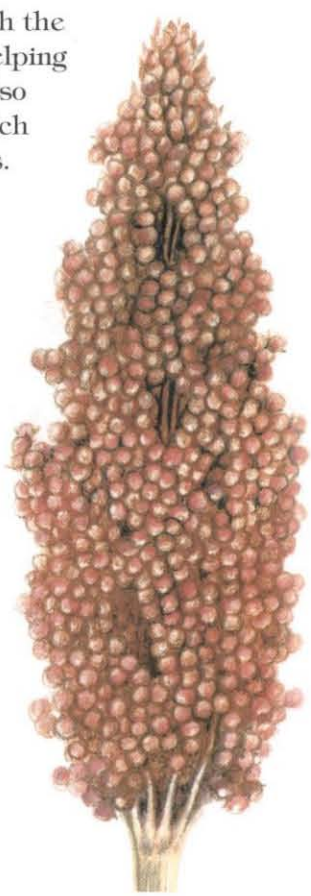
SAVING

Millions of years of evolution have created just a handful of crops upon which the world's food supply has come to depend. The value of these genetic resources to humankind is inestimable – and their loss would be irreversible.

Helping Eritrea rebuild after 30 years of war. Like many African countries, Eritrea is struggling to emerge from the ravages of war, and the vestiges of colonialism. Since 80% of its population works in agriculture, yet food production falls well short of sufficiency, agricultural development holds a high place on the Government's reconstruction agenda. A number of CGIAR centers are assisting the Ministry of Agriculture in the effort, with the targeted support of such donors as the International Fund for Agricultural Development and the Danish Government. ICRISAT's role is particularly vital because sorghum is the most important staple food crop in the country, and Eritrea and its neighboring countries are the geographic center of origin and diversity for the crop. The joint sorghum effort includes several dimensions: increasing productivity in different agro-ecosystems, conserving landraces, building infrastructural capacities for research and development, and training national scientists in research skills. ICRISAT, which holds the world's largest sorghum collection, is sharing its expertise with Eritrea by participating with the Ministry on collection trips, providing training and advice, and helping to upgrade seed storage and laboratory facilities. ICRISAT is also providing breeding lines from diverse sources, a number of which are promising enough to have reached advanced on-farm trials.



Unlocking the treasure chest. The treasure trove of qualities held in collections of crop germplasm at ICRISAT have only begun to be tapped. The sheer size of the collections, for example – 36,729 accessions of sorghum alone – makes screening this resource a daunting task in itself. New molecular and computer-based quantitative statistical methods are, however, enabling researchers to delineate close taxonomic relationships, and measure genetic distances and diversity with a precision never before possible. Scientists from CIRAD and ICRISAT are jointly identifying "core collections" of sorghum using these techniques. These studies have tentatively identified three core collections of some 200 accessions each, which sample the breadth of diversity of the entire genetic reserve. These collections should provide breeders with an efficient starting point in the search for valuable new traits, as well as for further diversity research.

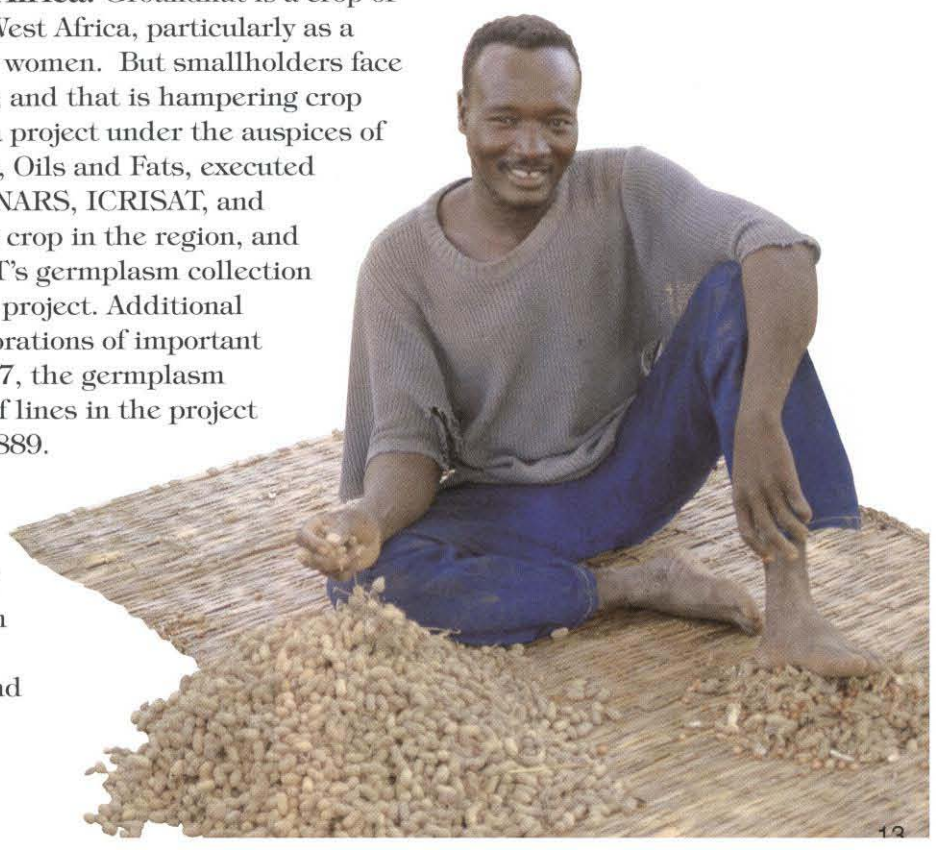


BIODIVERSITY

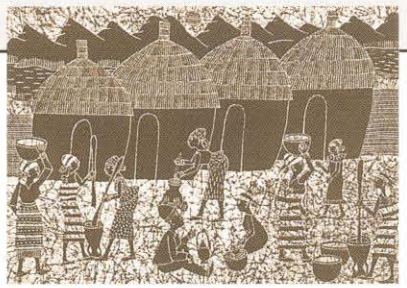
Going back for the future. The strong evidence of the potential economic value of saving biodiversity has convinced the world community to take the necessary steps to preserve the genetic heritage of major food crops. Through a 5-year collaborative project between EMBRAPA (Brazil), ICRISAT, and CIAT, funded since 1996 by the World Bank and the Common Fund for Commodities, collections of groundnut made during the 1980s by ICRISAT and EMBRAPA are being characterized and evaluated, with impressive initial results. One example is *Arachis kempff-Mercadoi*, a collection from Brazil that has tested immune to the devastating fungal disease late leaf spot, which causes global yield losses estimated at US$ 600 million annually. Six accessions of another wild *Arachis* species, *A. duranensis* — believed to be one of the progenitors of the cultivated groundnut — contained approximately 30% more protein than commercial varieties. These observations confirm that the wild species of *Arachis* hold great potential to improve cultivated groundnut — if efforts to conserve them are sustained.

Farmer knowledge helps researchers save biodiversity. "Landraces" - varieties selected over millennia by generations of smallholder farmers - are a precious repository of valuable traits and genetic diversity. In situ conservation efforts are seeking to sustain this delicate but dynamic balance - but must begin by learning how and why farmers select and maintain these lines. In collaboration with the University of Hohenheim and Indian Government and non-governmental organizations (CAZRI, NBPGR, RAU, Grameen Vikas Vigyan Samiti, Jodhpur, and the Social Work and Research Centre, Tilonia), ICRISAT is working with farmers along the desert margins of Rajasthan to gather indigenous knowledge about the valuable landraces of pearl millet grown there. Special communication techniques for accurately eliciting farmer knowledge are essential, and have been a focus of the project to date. In addition to biodiversity conservation, these methodologies will also help plant breeders work more effectively with farmers for crop improvement.

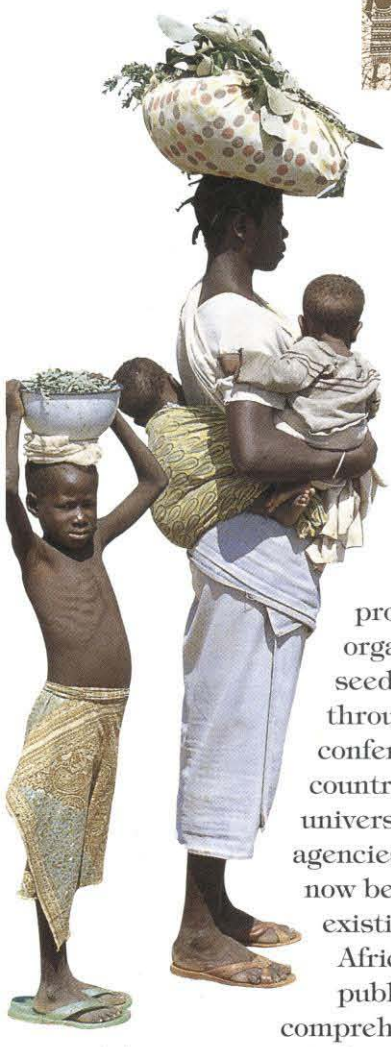
Sparking a groundnut revival in West Africa. Groundnut is a crop of major importance to smallholder farmers in West Africa, particularly as a source of protein for children, and income for women. But smallholders face a shortage of adapted, disease-resistant seed; and that is hampering crop productivity and stability. CFC is supporting a project under the auspices of FAO's Inter-Governmental Group on Oilseeds, Oils and Fats, executed through the CORAF network of West African NARS, ICRISAT, and CIRAD, to restore the genetic diversity of the crop in the region, and get seed of the best lines to farmers. ICRISAT's germplasm collection at Patancheru, India is a key resource for the project. Additional diversity is also being collected through explorations of important production areas in West Africa. Through 1997, the germplasm transfers and collections raised the number of lines in the project gene bank (housed at ICRISAT- Niamey) to 4889. Prominent components of the project include training and information dissemination, workshops, training courses, advanced degree supervision, and the dissemination of publications and databases. This West African effort compliments ICRISAT's GTZ-funded groundnut develoment project for southern and eastern Africa based in Malawi, with mutual exchanges of germplasm and technology.



IMPROVING

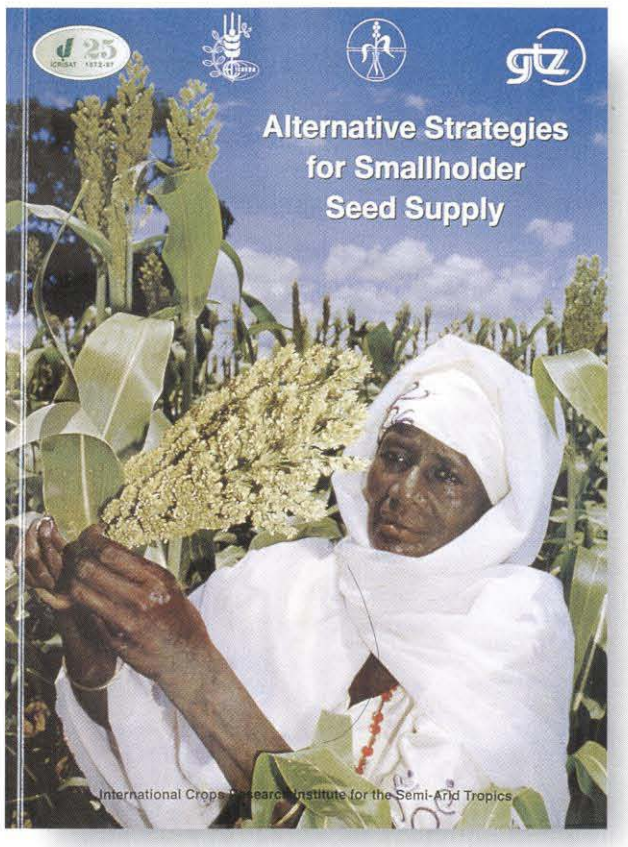


Agriculture would not exist without people, communities, and institutions — and cannot thrive unless these also evolve and adapt to a changing world.



Seeding a new future for Africa.

Sorghum and millet are crops of the poor – and as such, have difficulty attracting attention from commercial seed suppliers. However, the seed industry is flourishing in India, giving hope for a similar emergence in Africa – if appropriate policies and institutional relationships are encouraged. To help stimulate this process, ICARDA, IITA, and ICRISAT organized an international conference on seed systems in Harare, Zimbabwe in 1997 through the support of BMZ/GTZ. At the conference, attended by delegates from 18 countries (including NARS, NGOs, universities, private seed firms, and donor agencies), action plans were developed that are now being considered for implementation by existing and proposed seed networks in Africa and West Asia. The proceedings, published by ICRISAT, provide a comprehensive review of alternative seed delivery strategies for these regions.



Smoothing the path to adoption.

Socioeconomics research places high priority on understanding constraints to adoption, and overcoming them. As part of a concerted effort to bridge the technology adoption gap, scientists from INRAN (Niger) and ICRISAT have been working closely with their counterparts from ILRI, IFDC, ICRAF, and the University of Hohenheim to collate workable and simple technologies that researchers believe have a high likelihood of adoption – and are testing this hypothesis in the field. INRAN and ICRISAT scientists developed brief fact sheets in English and French for each technology in consultation with representatives from NGOs and extension services during a workshop in June 1997. The resulting catalogs – intended to be both dynamic and interactive – should help extension workers and other agents more effectively explain and discuss new technologies with farmers. The sheets also enable researchers to collect data to better understand farmer reluctance to adopt, and how to address their reservations.

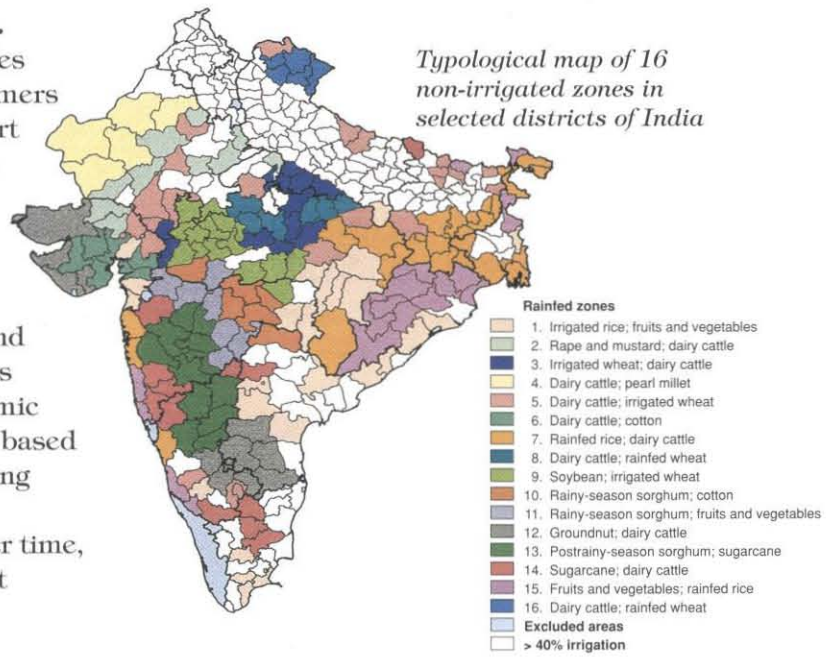
POLICIES

Technology sharing – the power of choice.

Too often in the past, technology was "transferred" rather than shared. As an example, official recommendations for fertility management are generally ignored – less than 5% of smallholders use chemical fertilizer on sorghum or pearl millet in Africa. ICRISAT and national programs are now reexamining their approaches to technology sharing – and finding that they must make it a process of dialogue, not simply information. Working with the national programs of Kenya, Malawi, and Zimbabwe, soil fertility scientists are developing an entire range of management options from which farmers can choose, depending on their objectives, resource levels, and risk preferences. This approach uses two new and powerful tools – simulation modeling and farmer-participatory research. Modeling allows scientists to narrow down management choices to a smaller range of best-bet options, which can then be tested through participatory experimentation with small-scale farmers. Initial simulations show that smallholders can significantly improve soil fertility by combining small quantities (much smaller than the official recommendations) of chemical fertilizer with farmyard manure.

Typology: learning from what farmers do.

Improvements to agricultural development policies require an intimate understanding of the way farmers currently use the land, and of its potential. As part of a major World Bank funded project carried out by ICAR, collaboration between ICRISAT and NCAP has demonstrated the power of a technique called "typology" using selected rainfed districts in parts of India. Because this method classifies land use by the types of crop and livestock production activities actually in progress on-farm, it holds greater relevance to socioeconomic analysis than conventional classification systems based solely on agro-ecological parameters. The resulting typological maps, generated by a geographical information system, can be efficiently updated over time, may become a strategic research and development planning tool in India.



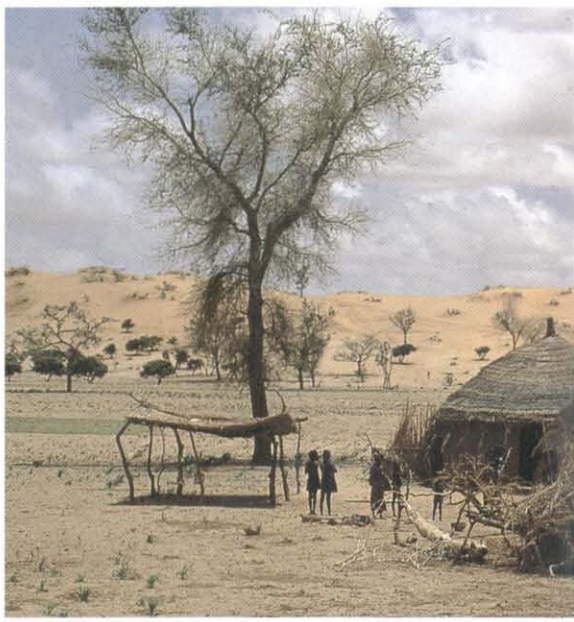
Typological map of 16 non-irrigated zones in selected districts of India

Sorghum in India: added value from new crop products. Sorghum remains the most important source of food and fodder for millions of farmers in the Indian semi-arid tropics. However, studies supported by DFID and carried out in collaboration with UK's NRI and such national partners as NSRC have found that the crop's competitive position in the marketplace is weakening relative to subsidized alternatives like wheat and rice. Additional crop products, such as stover (straw) for cattle feed, provide an opportunity to add enormous value to the crop, by contributing to increased dairy and meat production and animal draft power. Unlike human foodstuffs, bulky stover cannot be easily transported in from other agro-ecosystems, so sorghum and millet stover grown within the semi-arid tropics is especially valuable to farmers located there. ILRI, in partnership with ICRISAT, NAARM, and NDOR, carried out an ex ante impact assessment, concluding that an improvement of sorghum stover digestibility of just 1% would yield $43 million in annual benefits to India, even at an adoption rate of just 10%.

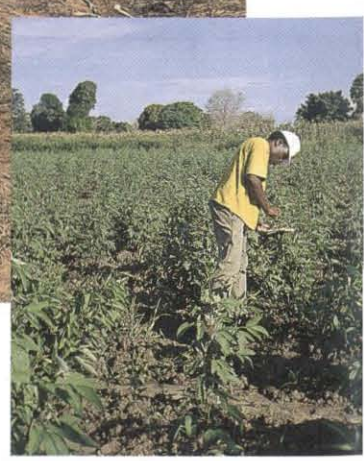
STRENGTHENING

ICRISAT's most immediate and intimate partners – upon whom the ultimate success of agricultural development depends.

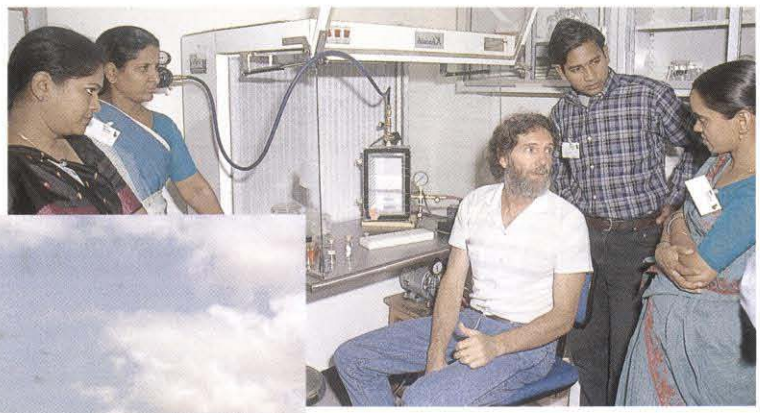
Standing together against desertification. The joint creation and execution of major development projects provides an ideal medium through which ICRISAT helps strengthen NARS partners. In response to the United Nations' Convention to Combat Desertification that emerged from the 1992 Earth Summit, the CGIAR created a system-wide Desert Margins Program (DMP), with ICRISAT in the convening role. Realizing that the problems are complex and wide-ranging, the DMP has been working hard to bring together a diverse set of NARS and other partners to tackle the challenge, and develop consensus about strategies and priorities. Donors are part of the consortium, supporting specific projects. As part of an IDRC-funded project to arrest land degradation in Botswana, Burkina Faso, and Kenya, DMP will help evaluate indigenous and new technologies through participatory research with farmers, NGOs, and NARS, develop technological options to arrest land degradation, and forge regional links that will facilitate information exchange on this vital subject.

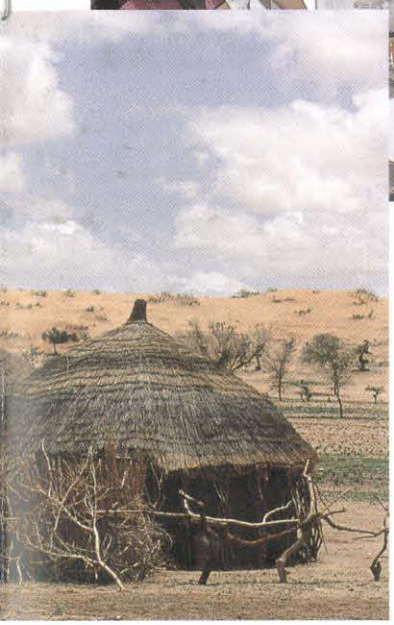


'Seeds of Freedom' to rebuild Angola. After 15 years of civil war, peace is returning to Angola – and with it, hopes for an agricultural revival. Working hand-in-hand to help the NARS get back on their feet, the Seeds of Freedom project was launched by the United States Agency for International Development with support from six CGIAR centers, several NGOs led by World Vision International, and the national programs of Malawi and Zimbabwe. In 1997, ICRISAT helped NARS to produce substantial quantities of seed of five improved sorghum and pearl millet varieties on their research stations. In the process, the Angolan NARS were also assisted to rebuild national research facilities and train staff. A training-the-trainers workshop during 1997 laid the foundation for wider efforts to promote improved production techniques. Several research staff from the Angolan national program underwent training courses on statistical analysis, breeding, and crop management at ICRISAT. Rebuilding will take time and money, but Seeds of Freedom ensures that donors' investment will yield long-term payoffs through strengthened national capacities.



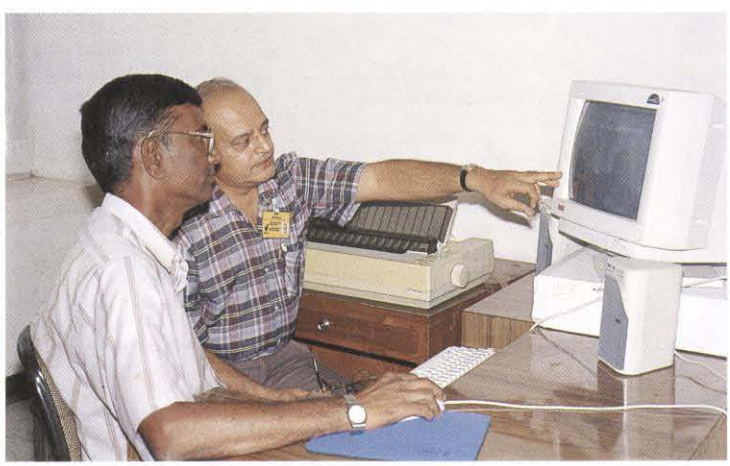
NATIONAL PROGRAMS





Delivering new gene technology to tropical scientists. Sometimes the technology needed to solve a crucial problem is available in developed countries, but is out of reach of national programs. ICRISAT is well suited to act as a conduit for technology sharing between advanced institutions and NARS.
As a contribution to a major collaborative project between ACIAR (Australia) and ICAR (India), ICRISAT is acting as a bridge to share new sorghum genetic transformation technology with national scientists. A workshop on the use of a specially designed particle-inflow gun (PIG) – used to bombard DNA particles to produce transgenic sorghum plants – was held at Patancheru in early 1998. With help from an ACIAR specialist, the 20 participants had an opportunity to learn how to use the PIG and explore the possibilities of locally manufacturing it. If this succeeds, NARS collaborators will have made a huge leap to catch up with the most advanced techniques currently used by sorghum breeders anywhere in the world.

Not just book learning. The Indian Council of Agricultural Research (ICAR) includes nearly 100 member institutions across the country, covering topics as wide-ranging as horticulture, soil science, veterinary science, goats, grapes, and soybean.



In 1997, 16 of these institutions sent their staff to the ICRISAT library at Patancheru for training on information systems analysis and application of information technologies. Participants learned about information systems analysis and design, flowcharts, information retrieval, database design, library automation, project proposal writing, software evaluation, networking, and the internet. The enthusiastic response to the course has led ICRISAT to plan future "train the trainers" internship courses, so that these skills can be more rapidly multiplied throughout ICAR and other potential clients.
The new course will be supported by multimedia tools that can be distributed with the participants.

Sharing pigeonpea with Africa. Pigeonpea is a hardy, drought-tolerant crop that has its origins in Asia, but offers multiple potential benefits to Africa. ICRISAT, with funding support from the African Development Bank, is helping NARS share germplasm and technology with farmers in southern and eastern Africa, through a web of partnerships that includes ten national programs, universities, women's groups, the private sector, and NGOs in seven countries. NARS/ICRISAT teams have identified varieties suited to specific production systems – for example, wilt-resistant long-duration varieties for Tanzania; insect-tolerant, short- and medium-duration varieties for Uganda; and high-yielding short-duration types for Kenya. Simultaneously, training courses on pigeonpea processing and utilization are helping to generate awareness and open new market opportunities. Sixteen such courses were held in 1997, in Kenya, Malawi, Tanzania, and Uganda.

All of ICRISAT's work is built upon a framework of partnerships. The following pages outline the major dimensions of partnership: the events, participants, projects, and joint endeavors in progress during 1997.

WORKSHOPS, CONFERENCES,

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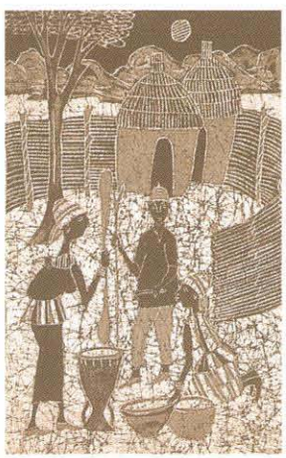

Event/Topic	Venue	Participants	Participating countries	Resources and collaborative support
Increasing Productivity				
Atelier sur Technologies transferables aux producteurs	ICRISAT-Niamey	60	Niger	World Bank/INRAN
Atelier sur Le developpement du palmier dattier dans les zones saheliennes d'Afrique	ICRISAT-Niamey	36	Algeria, Burkina Faso, Cameroon, Canada, Ethiopia, France, Israel, Kenya, Mali, Mauritania, Namibia, Netherlands, Niger, Senegal, Spain	FAO, IPALAC
Consultative meeting on priorities of research on pearl millet and means for strengthening partnership	ICRISAT-Niamey	17	Niger	ROCAFREMI
Sorhum improvement in Western and Central Africa; terminal review workshop of the joint sorghum program	ICRISAT-Bamako	60	Burkina Faso, Cameroon, Chad, Côte d'Ivoire, France, India, Mali, Niger, Nigeria, Togo	CIRAD/ICRISAT
Malawi groundnut sector stakeholder workshop	Mangochi, Malawi	34	Malawi	GTZ
Zambia groundnut sector stakeholder workshop	Lusaka, Zambia	25	Malawi	GTZ
Zambia groundnut extension training workshop	Chipata, Zambia	27	Zambia	GTZ
CARMASAK modeling review workshop	Machakos, Kenya	16	Kenya, India, Malawi, Niger, Zimbabwe	APSRU
CLAN coordinators steering committee meeting	Malang, Indonesia	24	Bangladesh, China, India, Indonesia, Iran,Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam, Yemen	
Asian sorghum scientists meeting	Thailand	23	Australia, China, India, Indonesia, Iran, Myanmar, Pakistan, Thailand	QDPI
Technology exchange workshop on advances in pearl millet downy mildew research	ICRISAT-Patancheru	7	India	ICAR, Gujarat State Fertilizers and Chemicals Ltd.
Global conference on ergot of sorghum	Sete Lagoas, Brazil	60	Argentina, Australia, Brazil, Columbia, Honduras, Mexico, USA, India, Urugway, Venezuela, Zimbabwe	EEA-INTA, DPI, EMBRAPA, ARC-LNR, Imperial College, INTSORMIL, Texas A&M Universities/USDA, AGRONOVA, University of Zimbabwe
Development of cytoplasmic male sterility in pigeonpea	BARC, Mumbai, India	16	Indian NARS including ICAR, seed companies	
Pigeonpea entomologists meeting	ICRISAT-Patancheru	20	ICAR, NGOs, KVKs, Indian Universities	
The use of molecular markers for pearl millet, improvement in developing countries	ICRISAT-Patancheru	61	India, Italy, Niger, South Africa, UK, USA	NCBS, TIFR, IPGRI, CSIR-Foodtek, DFID, University of Wales John Innes Centre, ODI, IGER
Nematode pests in rice-wheat-legume cropping systems	Hisar, India	13	Bangladesh, India, Nepal	RWC, ICAR, HAU, AICRIP/IARI, CABI, Cornell University
Protecting the Environment				
Methodology workshop of the Desert Margins Program and Interim Steering Committee meeting	ICRISAT-Niamey	40	Burkina Faso, Bostwana, Canada, Cameroon, France, Kenya, Mali, Niger, Nigeria, Senegal, South Africa, Switzerland, Zimbabwe	
Experimental designs for agroforestry research	Ouagadougou, Burkina Faso	17	Benin, Burkina Faso, Mali, Niger, Senegal	ICRAF, University of Ouagadougou, ICRISAT
Training program on theory and practice of improved Vertisol management technology	Debre Birhan, Ethiopia	30	Ethiopia	AUA, IAR, ILRI, the Ministry of Agriculture Extension Services, Ethiopia
Legumes in rice and wheat cropping systems of the Indo-Gangetic Plain - constraints and opportunities workshop	ICRISAT-Patancheru	42	Bangladesh, India, Nepal, Pakistan	AVRDC, Cornell University
Saving Biodiversity				
Gene bank management training course	ICRISAT, Niger	16	Burkina Fao, Central African Republic, Côte d'Ivoire, Ghana, Guinee, Guinee Bissau, Mali, Niger, Nigeria, Senegal, Togo	CFC
In-country training course on planning and lay-out of experiments, experimental techniques, and data recording	Eritrea	15	Eritrea	
In-country training course on insect pest survey and management in sorghum	Eritrea	9	Eritrea	

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Improving Policies				
Sorghum network sponsored training course on the diversification of the utilization of sorghum	IER - Bamako,	19	Burkina Faso, Chad, Côte d'Ivoire, Mali, Togo	PROCELOS
Risk workshop with stakeholders on modelling and farmer participatory research approaches to soil fertility research in drought-prone Southern Africa	Kadoma, Zimbabwe	32	Australia, Malawi, Mexico, Zimbabwe	APSRU
Zimbabwe national sorghum/millet program workshop	Harare, Zimbabwe	46	Zimbabwe	Zimbabwe NARS
Enhancing research impact through improved seed supply: options for strengthening national and regional seed supply systems	Harare, Zimbabwe	70	Algeria, Côte d'Ivoire, Egypt, Ethiopia, Ghana, Kenya, Malawi, Morocco, Namibia, Pakistan, Sierra Leone, Sudan, Syria, Tanzania, Turkey, Yemen, Zambia, Zimbabwe	GTZ, ICARDA, IITA
Farmer participatory research approaches	Harare, Zimbabwe	46	Angola, Botswana, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe	CIAT, GTZ, SAFIRE
Iimproving risk management strategies for resource-poor farmers in drought-prone areas	Kadoma, Zimbabwe	30	Kenya, Malawi, South Africa, Mexico, Zimbabwe	APSRU, Australia
Strengthening National Programs				
Agricultural research management	Nigeria	12	Cameroon, Ghana, Nigeria, Tanzania, Uganda	IITA, ISNAR, WARDA
Maintenance of laboratory equipment	Niger	11	Algeria, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Rwanda, Togo	IITA, INRAN, SPALNA, ICRISAT
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Chickpea collaborators travelling workshop	Hisar, Modipuram, Pantnagar, Gwalior, ICRISAT-Patancheru	17	Bangladesh, India, Iran, Nepal	
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Information system analysis and application of information technologies in ICAR libraries	ICRISAT-Patancheru	16	ICAR, India	CCMB
Workshop/training course on GIS techniques for agro-ecosystems characterization	ICRISAT-Patancheru	30	Bangladesh, India, Nepal, Pakistan, Sri Lanka	CIAT, NRSA, NBSS&LUP, CIMMYT, FAO, ICIMOD, IRRI, Cornell University, NRCS, DOA, Rice-Wheat Project, USA
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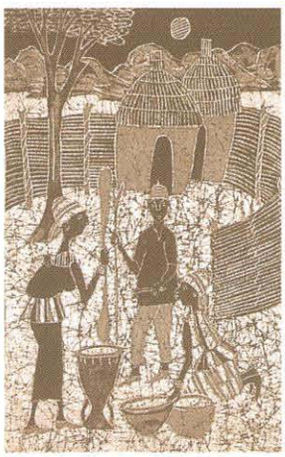

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Experimental design for agroforestry research	Burkina Faso	17	Benin, Burkina Faso, Mali, Niger, Senegal	ICRAF
Computer-aided biometric-design and analysis in agricultural research	Benin	15	Benin	INRAB

RESEARCH SCHOLARS

Building a scientific cadre for tomorrow — ICRISAT scientists, in collaboration with universities around the world act as mentors and provide excellent facilities for students seeking advanced degrees in the agricultural sciences.

Name	Country of Origin	Degree Sought	Study Topic
J A Able	*Australia*	PhD	Genetic transformation using electroporation of mesolphyll protoplasts.
M Ajitha	*India*	PhD	Characterization of chickpea genotypes identified for core collections.
V Anita	*India*	PhD	Applied ecology of white grubs in groundnut in Andhra Pradesh.
V Anjaiah	*India*	PhD	Biological disease control of wilt and collar rot of pigeonpea and chickpea.
M Bharathi	*India*	PhD	Integrated management of pigeonpea wilt caused by *Fusarium udum*.
M Bhukta	*India*	MSc	Effects of photoperiod on growth and partitioning in groundnut.
S Boureiema	*Niger*	PhD	Pearl millet topcross hybrids for Niger.
Elasha A Elasha	*Sudan*	PhD	Interactions of sowing date, soil fertility, shoot fly protection and cultivar in postrainy-season sorghum.
M Gandah	*Niger*	PhD	Study of soil spatial variability on nutrient and water availability.
G S Geetha	*India*	PhD	Enhancement of resistance to *Botrytis* gary mold of chickpea using PGIP genes.
K Gopal	*India*	PhD	Transmission of, and screening for resistance to a peanut bud necrosis virus in groundnut.
B Jayanand	*India*	PhD	Regeneration of chickpea from tissue cultures.
P D Kamala Jayanthi	*India*	PhD	Genetics of shoot fly resistance in sorghum hybrids.
K Kanaka Durga	*India*	PhD	Studies on cytoplasmic systems and hybrid types for yield characters in sorghum.
Alok Kumar	*India*	MEng	Modeling small agricultural watersheds for land and water development.
P Lava Kumar	*India*	PhD	Genetic variation within *Aceria cajani*, the mite vector of sterility mosaic of pigeonpea.
S Audi Lakshmi	*India*	PhD	Genetics of grain mould resistance and yield components in sorghum.
A V V Lakshmi	*India*	MSc	Diversity among sorghum genotypes using molecular markers.
K Madhuri	*India*	MSc	Biology and parasitization behavior of *Gryon* sp. in pigeonpea.
K Mazvimavi	*Zimbabwe*	PhD	Economics of sorghum diversity in smallholder systems of southern Zimbabwe.
K P Nagavellemma	*India*	PhD	Evaluation of land surface practices on Vertic Inceptisols.
M Nivedita	*India*	PhD	Profile moisture storage, deep percolation, and solute movement in an Alfisol.
G O Omanya	*Kenya*	PhD	Evaluation of indirect vs direct selection methods for *Striga* resistance in sorghum.
B Padmasri	*India*	MSc	Plant stand establishment in rainfed chickpea: factors related to seed.
J Padmavathi	*India*	PhD	Molecular genetic analysis of the entomopathogenic fungus *Beauveria bassiana*.
P Padmavathi	*India*	PhD	Sustainable soybean production in Vertic Inceptisols.
A Malima Perera	*Sri Lanka*	PhD	Water logging and drought resistance in short-duration pigeonpea.
M Phiri	*Malawi*	MSc	Small scale seed production and adoption of groundnut variety CG 7 in Malawi.
Prahalad Puranik	*India*	MSc	Dynamics of sporangia production in *Sclerospora graminicola*.
Md Lutfur Rahman	*Bangladesh*	PhD	Studies on the races of chickpea wilt *Fusaria* in India.
T Shyamala Rani	*India*	PhD	Tissue culture studies in pearl millet with special reference to production of dihaploids.
C Sudha Rani	*India*	PhD	Modelling response of castor to water, nitrogen, sowing date, and cultivar.
K L Reddy	*India*	PhD	Epidemiology of peanut bud necrosis virus.
S H Sabaghpour	*Iran*	PhD	Association of earliness with yield-contributing characters in chickpea.
K Sailaja	*India*	PhD	Role of betaines on the alleviation of drought stress in groundnut.
O Samake	*Mali*	PhD	Optimizing fallow use in millet cropping systems in Mali.
S J Sastry	*India*	PhD	Molecular genetics of pathogenic variability in pearl millet downy mildew.
P Satchidanand	*India*	MSc	DNA markers related to drought resistance in sorghum.
F Sinaba	*Mali*	PhD	Ecology of groundnut nematodes in Mali.
B U Singh	*India*	PhD	Host plant resistance to shoot fly, stem borer, and head bug in sorghum.
T Rupa Singh	*India*	PhD	Vesicular arbuscular mycorrizae in relation to pigeonpea nutrition.
Yash Pal Singh	*India*	PhD	Panicle branch length and diameter effects on grain productivity in pearl millet.
M Sreelatha	*India*	MSc	Pathogenicity of *Meloidogyne* sp. to groundnut.
V Srinivas	*India*	MSc	Trap crops (sunflower and castor) to control *Spodoptera* in postrainy-season groundnut.
R K Srivastava	*India*	MSc	Pentrance and expressivity of twin-podded character in chickpea.
D Subrahmanyam	*India*	MSc	Morphological factors for resistance to shoot fly in sorghum.
G Suhasini	*India*	PhD	Investigations on the induction of haploidy in *Arachis* spp. by anther culture.
N Taylor	*UK*	IH	Collection and analysis of socio-economic data, and database development.
F T Tesfaye	*Ethiopia*	MSc	Inheritance studies for seed size in chickpea.
J P Tiendrebeogo	*Burkina Faso*	PhD	Optimizing manure management at village level in Burkina Faso.
K Venkateswaran	*India*	PhD	Genetic and molecular characterization of wild and cultivated species of sorghum.
N V S Vijayalakshmi	*India*	MSc	Screening for drought resistance.
M Weigl	*Germany*	IH	Collection and analysis of socio-economic data, and database development.
Su Su Win	*Myanmar*	MSc	Groundnut and sesame-based cropping systems on Alfisols.

AFFILIATED SCIENTISTS

ICRISAT's compelling mission, web of partnerships, and top-class research facilities attract collaborating scientists from around the world. They share ideas, skills, and resources, leveraging added value for development investors.

Name	Country of Origin	Parent Institution	Activity	Location
Md Abdurahman	*Somalia*	ARI, Somalia	Quantification of *Polymyxa* sp in Indian soils	Patancheru
L Achoth	*India*	UAS	Alternative crops for resource use efficiency in India	Patancheru
I Akintayo	*Togo*	ICRISAT	Coordinator, WCASRN	Bamako
G L Anderson	*UK*	Univ Aberdeen	Changes in strength characteristics in Alfisols	Patancheru
A Bationo	*Burkina Faso*	IFDC	Fertility improvement in Sahelian soils.	Niamey
C M Busolo-Bulafu	*Uganda*	NARO	Groundnut resistance to rosette and early leaf spot	Lilongwe
K von Brocke	*Germany*	Univ of Hohenheim	Enhancing farmers' pearl millet genetic resources	Rajasthan
P Chengappa	*India*	UAS	Alternative crops for resource use efficiency in India	Patancheru
A Christinck	*Germany*	Univ of Hohenheim	Farmers knowledge of indigenous pearl millet in Rajasthan	Patancheru
S B Coulibaly	*Mali*	IER	Review of sorghum drought research in West Africa	Bamako
T K Dattaroy	*India*	NCL	Simple sequence repeat analysis for grain mold resistance	Patancheru
P Delfosse	*Belgium*	Univ Louvain	Peanut clump virus epidemiology and control	Patancheru
C M Deom	*USA*	Univ Georgia	Monitoring groundnut rosette viral heterogeneity on-farm	Lilongwe
K Dossa	*Togo*	Univ Hohenheim	Nutrient fluxes in the West African Sahel	Niamey
C Durairaj	*India*	TNAU	Summarize ICAR/ICRISAT collaborative project data	Patancheru
F Graef	*Germany*	Univ Hohenheim	Database for yield and risk assessment	Niamey
P Grarad	*France*	CIRAD	*Striga* integrated management	Bamako
C Grenier	*France*	CIRAD	Genomic/informatic definition of sorghum core collections	Patancheru
Y Grini	*Morocco*	Univ Hohenheim	Market access/agricultural development in western Niger	Niamey
J Haigis	*Germany*	Univ Hohenheim	Socioeconomics/adoption of agricultural innovations in Niger	Niamey
A Hall	*UK*	NRI/ODI	Postharvest losses and quality of sorghum in rural areas	Patancheru
B Haussmann	*Germany*	GTZ/BMZ	Biotechnology for improving resistance to *Striga* in sorghum	Bamako
P Hiernaux	*France*	ILRI	Livestock mediated nutrient transfers in the Sahel	Niamey
O E O Ibrahim	*India*	ARC, Sudan	International Crop Information System development	Patancheru
S Ishikawa	*Japan*	JIRCAS	P and N uptake by sorghum and pigeonpea	Patancheru
H Joubert	*South Africa*	ARC	Selection of groundnut varieties for superior performance	Lilongwe
N L Joshi	*India*	CAZRI	Development of a millet model using APSIM	Patancheru
F M Kimmins	*UK*	NRI	Epidemiology of groundnut rosette in Malawi	Lilongwe
M Kolesnikova	*Russia*	DFID	Marker-assisted selection for downy mildew resistance	Patancheru
F Mahler	*Germany*	Univ Hohenheim	Livestock related nutrient transfers and cropland fertility	Niamey
P S Marley	*Nigeria*	IAR, Ahmadu Bello	Anthracnose variability studies	Kano and Zaria
K Mathur	*India*	RAU	Anthracnose variability studies	Patancheru
A Mayeux	*France*	CIRAD	Revitalization of groundnut in West Africa	Dakar
K N Murthy	*India*	Univ Hyderabad	Supply and demand functions for ICRISAT mandate crops	Patancheru
T Nakamura	*Japan*	JIRCAS	Adaptation to low N and P in sorghum and pigeonpea	Patancheru
H Nakano	*Japan*	JIRCAS	Government of Japan Project Team Leader	Patancheru
F E Nwilene	*Nigeria*	Univ Copenhagen	Postharvest compendium for FAO	Patancheru
A O Ogungbile	*Nigeria*	IAR, Ahmadu Bello	Impact of sorghum and land-use systems in Nigeria	Kano
V B Ogunlela	*Nigeria*	IAR, Ahmadu Bello	Assessment of sorghum landraces and improved varieties	Kano and Zaria
B Ouendeba	*Niger*	ICRISAT	Coordinator, ROCAFREMI	Niamey
H Rabé	*Niger*	Univ Hohenheim	Mechanisation of field work using animal traction	Niamey
G V Ranga Rao	*India*	IFAD	Integrated pest management for pulse pests in southern Asia	Patancheru
S V Rao	*India*	NRCS	Sorghum protoplast tissue culture/regeneration	Patancheru
A Ratnadass	*France*	CIRAD	Interactions of grain mold/head bug resistance in sorghum	Bamako
P V Reddy	*India*	ANGRAU	Water-use efficiency and drought tolerance	Patancheru
S Fernandez-Rivera	*Mexico*	ILRI	Feeding strategies for ruminants in crop-livestock systems	Niamey
B S Sidhu	*India*	PAU	Rice-wheat nutrients; data analysis and documentation	Patancheru
K Sreenivasulu	*India*	NRCS	Sorghum protoplast tissue culture/regeneration	Patancheru
P V S S K Vinayak	*India*	Earth Science Centre	Sustainable rainfed research and development (World Bank)	Patancheru
T O Williams	*Nigeria*	ILRI	Socioeconomics of livestock in mixed smallholder systems	Niamey
O P Yadav	*India*	RAU	Summarize joint multilocational trial data	Patancheru
A Yamamato	*Japan*	JIRCAS	Kinetics of N uptake in sorghum and pigeonpea	Patancheru
E Zerbini	*Italy*	ILRI	Improvement of feed quality of sorghum and millet	Patancheru

A number of development investors targeted part or all of their

Donor	Project	Collaborators
African Development Bank	Improvement of pigeonpea in eastern and southern Africa	NARS of Kenya, Malawi, Mozambique, Namibia, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe
Asian Development Bank	Strengthening regional collaboration on cereals and legumes research in Asia	NARS of Bangladesh, China, India, Indonesia, Myanmar, Nepal, Pakistan, Philippines, Thailand, Sri Lanka, Vietnam, NGOs, and private sector.
	ICRISAT/Sri Lanka pigeonpea intercropping and diversification study	NARS of Sri Lanka
Australia	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
	Overcoming production constraints to sorghum in rainfed environments in India and Australia	APSRU, CSIRO and University of Queensland (Australia), ICAR (India).
	Spillover impact of ICRISAT research on breeding programs and agricultural production in Australia	NSW Agriculture (Australia)
	Developing high N_2 fixing variants of chickpea andpigeonpea for a range of environments	ARC-NSW, CSIRO
Belgium	Integrated control of *Polyxma graminis*, a vector of peanut clump virus	Université catholique de Louvain, Louvain-la-Neuve (Belgium), NARS of India, Pakistan, Senegal, Burkina Faso
	Vrije Univesiteit Brussel (VUB)/ICRISAT collaborative project on biotechnology	Vrije Universiteit Brussel
France	Constitution of a sorghum core collection	CIRAD/ORSTOM
Common Fund for Commodities (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*	CENARGEN (Brazil)
Ford Foundation	Changes in dryland cropping patterns and resource use efficiency	NCAER, University of Hyderabad (India)
Germany — BMZ / GTZ	Utilization of fungal antagonists for the control of *Striga* in West Africa	University of Giessen, and Biologische Bundesanstailt für Land und Forstwirtschaft (Germany).
	Validating farmers' varietal characterization and production constraints: pearl millet in Rajasthan	University of Hohenheim (Germany), Gramin Vikas Vigyan Samiti, and local farmer groups in western Rajasthan, India.
	Impact of cropping systems on the searching and parasitization behavior of *Trichogramma chilonis* Ishii, an egg-parasitoid of *Helicoverpa armigera* (Hübner)	Central Integrated Pest Management Centre (India), Institut für Phytomedicin, Hohenheim University (Germany).
	Promotion of sorghum and millet cultivation in southern Africa	NARS, NGOs, private sector seed companies, farmers
	Promotion of legume cultivation in SADC (Phase IV)	NARS in 12 SADC Member States, NGOs, Action Aid, Christian Science Committee, World Vision, Oxfam, Concern Universal, International Eye Foundation
	Striga resistance in sorghum	University of Hohenheim, Eberhard-Karls Tübingen University (Germany)
	Enhancing the quality, diversity, and productivity of farmers' pearl millet genetic resources in Rajasthan, India Workshop on a local seed supply systems: constraints and prospects	NBPGR, CAZRI, Rajasthan Agricultural University (India), University of Hohenheim (Germany) ICARDA, IITA, Food Security Technical and Administrative Unit, SADC
	Farmers' participation in watershed management in India	NGOs (India), University of Hohenheim (Germany)
University of Hohenheim	The use of rock phosphate in agro-pastoral rotational systems in southern Niger (ROTAPHOS)	IFAD
ICAR / World Bank	Sustainable rainfed agriculture research and development project (Module 1)	ICAR (India), IFPRI
IFAD / World Bank	Collaborative research of sorghum based crop production systems in eastern lowland wadis of Eritrea	NARS of Eritrea

BY TARGETED DONOR GRANTS

contributions to particular areas of ICRISAT's work in 1997.

Donor	Project	Collaborators
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
Inter-American Development Bank	A research and network strategy for sustainable sorghum production systems for Latin America	NARS of Latin America, CIAT
Iran	Training activities for Iranians at ICRISAT Patancheru	Acharya N G Ranga Agricultural University, Central Research Institute for Dryland Agriculture (CRIDA) (India).
Japan	Sustainable cultivation of upland crops in the semi-arid tropics	JIRCAS, MAFF Japan
	Development of methods of evaluation of environmental changes associated with the conversion of forest land into agricultural land in the tropics and strategy for the promotion of sustainable land use systems	JIRCAS
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.
Rockefeller Foundation	Methodology to develop practical soil fertility technologies through farmer / researcher partnerships	NARS of Malawi
Swiss Agency for Development and Cooperation (SDC)	West and Central African millet research network ROCAFREMI (Phase IV)	National extension workers, NGOs and farmers, INTSORMIL/ICRISAT
UK – DFID	Enhancement of resistance to botrytis grey mould of chickpea using PGIP genes	Scottish Crop Research Institute (SCRI), University of Auckland (New Zealand), ICAR (India)
	Assessment of the genetic variation within and between populations of *Aceria cajani*, the mite vector of the agent of sterility mosaic of pigeonpea, in different regions of Asia	SCRI (UK), ICAR (India), NARS of Nepal and Myanmar
NRI / DFID	Sorghum in India (a) technical, policy, economic, and social factors affecting improved utilization, (b) quality and safety of traditional foods, (c) postharvest losses and quality of sorghum for food and feed in rural areas	NRI (UK), National Centre for Research on Sorghum (NRCS), Indian Grain Storage Research Institute, Central Food Technology Research Institute (India)
UNDP	Comparative study on factors critical to the adoption of ICRISAT/NARS groundnut innovations	University of Arizona (USA), OPI (Vietnam), NRCG (India)
USAID	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
	Strengthening national agricultural research systems in Africa through collaborative research networks	NARS of participating countries, NGOs, and private sector
	Regional sorghum and millet research project for southern Africa	NARS, NGOs, private sector seed companies, farmers
	Seed production and marketing of sorghum hybrid, NAD-1 in Niger	INRAN, private sector seed companies, INTSORMIL/ICRISAT
	Chickpea molecular marker / mapping work	Washington State University (USA)
	Molecular markers for crop improvement in groundnut	University of Georgia (USA)
	Search for *Striga* resistance in wild relatives of pearl millet	University of Georgia (UGA)/USDA-ARS Forage and Turf Research Unit, UGA Coastal Plain Experiment Station (USA)
	Assessing hydrology and crop production in a spatially variable terrain	Michigan State University (USA)
	Biotechnological tools for improving sorghum for *Striga* resistance	Purdue University (USA)
	Biotechnological approach to grain mold resistance in sorghum	Texas A&M University (USA)
	Strengthening drought mitigation work in southern Africa	NARS of southern Africa
University of New Jersey (Rutgers)/ World Bank	Study of the seed industry in India	Private sector seed companies and the public sector (India)
Pool of donors	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.

Targeted support for Core Programs from Japan, Netherlands, UK, and the OPEC Fund is not listed – but is included in the Financial Summary.

PUBLICATIONS

Getting the word out – with clarity, speed, and style. ICRISAT is keen to share the information it produces with as wide an audience as possible.
In 1997, 12 titles were copublished, and 16 different language versions were produced.
Copies are available from the Distribution Unit, ICRISAT, Patancheru.
Order by the codes given with each entry.

Books

FAO. 1997. L'economie mondiale du sorgho et du mil: Faits, tendances et perspectives. Order code: BOF 023.
Also published in Spanish BOS 023.
Copublished with the Food and Agriculture Organization of the United Nations, Italy.

Allen, D.J., and **Lenné, J.M.** (eds.). 1997. The pathology of food and pasture legumes. Wallingford, UK: CAB International.
Published in association with ICRISAT.

Sharma, H.C., Singh, F., and **Nwanze, K.F.** (eds.) 1997. Plant resistance to insects in sorghum. BOE 025.

Workshop Proceedings

Rohrbach, D.D., Kolavalli, S., and **Kolli, R.D.** (eds.) 1997. Gender research methodologies for agricultural research in India: summary and recommendations of a Workshop, 27-28 May 1996, ICRISAT Asia Center, Patancheru, India. CPE 108.

Reddy, D.V.R., Delfosse, P., Lenné, J. M., and **Subrahmanyam, P**.(eds.) 1997. Groundnut virus diseases in Africa: summary and recommendations of the Sixth Meeting of the International Working Group, 18-19 Mar 1996, Agricultural Research Council, Plant Protection Research Institute, Pretoria, South Africa. CPE 109.
Copublished with the Belgian Adminstration for Development Cooperation.

Mehan, V.K., and **Gowda, C.L.L.** (eds.) 1997. Aflatoxin contamination problems in groundnut in Asia: proceedings of the first Asia Working Group Meeting, 27-29 May 1996. Ministry of Agriculture and Rural Development, Hanoi, Vietnam. CPE 110.

Seeling, B., and **Joshi, N.L**.(eds.) 1997. From research station to farmer's field; nutrient management research for millet-based cropping systems of western Rajasthan; proceedings of a planning workshop, 20-22 May 1996, Jodhpur, India. CPE 111.
Copublished with the Central Arid Zone Research Institute, India.

Haware, M.P., Lenné, J.M., and **Gowda, C.L.L**.(eds.) 1997. Recent advances in research on botrytis gray mold of chickpea: summary proceedings of the Third Working Group Meeting to Discuss Collaborative Research on Botrytis Gray Mold of Chickpea, 15-17 Apr 1996, Pantnagar, Uttar Pradesh, India. CPE 112.

Rupela, O.P., Johansen, C., and **Herridge, D.F.** (eds.) 1997. Extending nitrogen fixation research to farmers' fields: proceedings of an International Workshop on Managing Legume Nitrogen Fixation in the Cropping Systems of Asia, 20-24 Aug 1996, ICRISAT Asia Center, India. CPE 113.

Rohrbach, D.D., Bishaw, Z., and **van Gastel, A.J.G.** (eds.) 1997. Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe. CPE 114.

Sharma, S.B. (ed.) 1997. Diagnosis of key nematode pests of chickpea and pigeonpea and their management: proceedings of a Regional Training Course, 25-30 Nov 1996, ICRISAT, Patancheru, India. CPE 115.

Bantilan, M., and **Joshi, P.K.** (eds.) 1997. Integrating research evaluation efforts: proceedings of an International Workshop, 14-16 Dec 1994, ICRISAT, Patancheru, India. CPE 116.

Information Bulletins

Thakur, R.P. et **King, S.B.** 1997. Ergot du mil. Bulletin d'information no.24. IBF 024.

Thakur, R.P. et **King, S.B.** 1997. Charbon du mil. Bulletin d'information no. 25. IBF 025.

Reddy, M.V., Raju, T.N., Sharma, S.B., Nene, Y.L., and **McDonald, D.** 1997. Handbook of pigeonpea diseases. (In Nepali). Information Bulletin no. 42. IBN 042.

Sharma, H.C., and **Nwanze, K.F.** 1997. Mechanisms of resistance to insects in sorghum and their usefulness in crop improvement. Information Bulletin no. 45. IBE 045.

Youm, O., Harris, K.M. et **Nwanze, K.F.** 1997. *Coniesta ignefusalis* (Hampson), le foreur du mil: un manuel d'information. Bulletin d'information no. 46. IBF 046.

Singh, S.D., Wilson, J.P., Navi, S.S., Talukdar, B.S., Hess, D.E., and **Reddy, K.N.** 1997. Screening techniques and sources of resistance to downy mildew and rust in pearl millet. Information Bulletin no. 48. IBE 048.

Brouwer, J., and **Bouma, J.** 1997. Soil and crop growth variability in the Sahel: highlights of research (1990-95) at ICRISAT Sahelian Center. Information Bulletin no.49.IBE 049.
Also published in French IBF 049.
Copublished with the Agricultural University, Wageningen, The Netherlands.

Singh, A.K., Mehan, V.K., and **Nigam, S.N.** 1997. Sources of resistance to groundnut fungal and bacterial diseases: an update and appraisal. Information Bulletin no. 50. IBE 050.
Also published in French IBF 050.

Pande, S., Bock, C.H., Bandyopadhyay, R., Narayana, Y.D., Reddy, B.V.S., Lenné, J.M., and **Jeger, M.J.** 1997. Downy mildew of sorghum. Information Bulletin no.51. IBE 051

Jagdish Kumar, Singh, N.B., van Rheenen, H.A., Johansen, C., Asthana, A.N., Ali, M., Agrawal, S.C., Pandey, R.L., Verma, M.M., Gaur, R.B., Satyanarayana, A., Patil, M.S., Rahman, M.M., Saxena, N.P., Haware, M.P., and **Wightman, J.A.** 1997.
Growing chickpea in India. GAE 033.
Copublished in Hindi (GAH 033), Gujarati (GAG 033), and Oriya (GAO 033) with the Indian Council of Agricultural Research.

Technical Manuals

Gomez, M.I., Obilana, A.B., Martin, D.F., Madzvamuse, M., and **Monyo, E.S.** 1997.Manual of laboratory procedures for quality evaluation of sorghum and pearl millet. Technical Manual no. 2. TME 002.

Laryea, K.B., Pathak, P., and **Katyal, J.C.** (eds.). 1997. Measuring soil processes in agricultural research. Technical Manual no.3. TME 003.
Copublished with the Central Research Institute for Dryland Agriculture, India

Plant Material Descriptions

Pearl millet variety TSPM 91018. PME 063.

Pearl millet variety SDMV 89004. PME 064.

Finger millet genetic male-sterile line INFM 95001. PME 071.

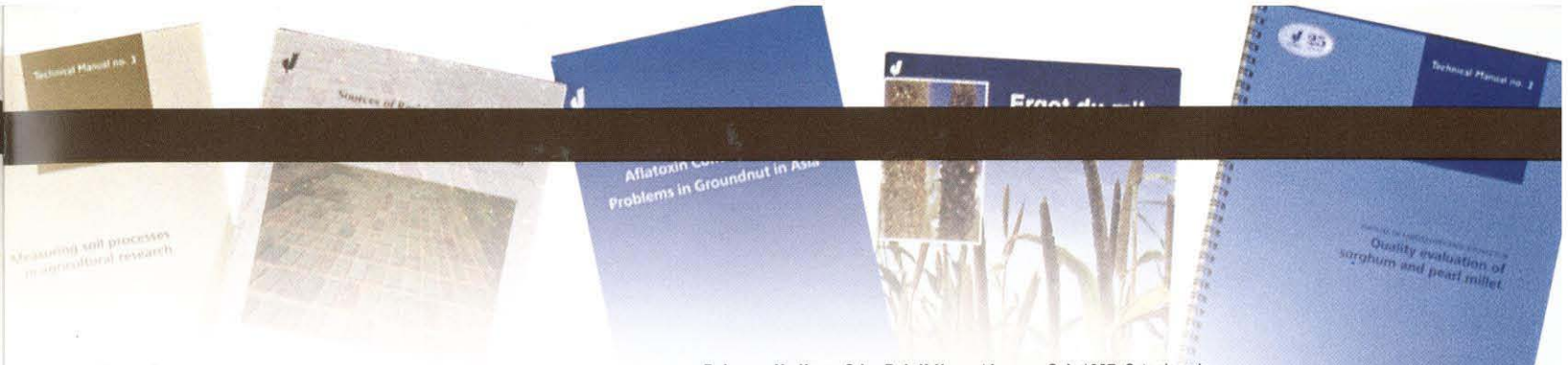
Groundnut variety ALR 2. PME 072.

Groundnut elite germplasm ICGV-SM 83005. PME 73.

Groundnut elite germplasm ICGV-SM 85048. PME 74.

Groundnut elite germplasm ICGV-SM-86715. PME 75.

Groundnut elite germplasms ICGV 92196, ICGV 92206, ICGV 92234, and ICGV 92243. PME: 076.



Newsletters

ICRISAT. 1997. International Chickpea and Pigeonpea Newsletter no. 4. ICPN 4.

Peanut CRSP and **ICRISAT.** 1997. International *Arachis* Newsletter no. 17. IAN 17.
Copublished with Peanut-CRSP.

SICNA and **ICRISAT.** 1997. International Sorghum and Millets Newsletter no. 38. ISMN 38.
Copublished with Sorghum Improvement Conference of North America.

Ergot - una enfermedad que ataca al sorgo. Supplement to ISMN 38
Copublished with National Sorghum Grain Producers, USA.

Food from Thought

A silent pulse revolution FTE 005.

A triple alliance towards prosperity FTE 006.

A rainbow painted on the last frontier FTE 007.

General Audience

ICRISAT Publications Catalog 1996. GAE 009.
Supplement: Non-English editions. GAO 009.

The hero of the Sahel
Also published in French.

Will they eat tomorrow ???
Also published in Telugu, Hindi, Japanese, French, and Portuguese.

This is ICRISAT
Published in Japanese and Danish.

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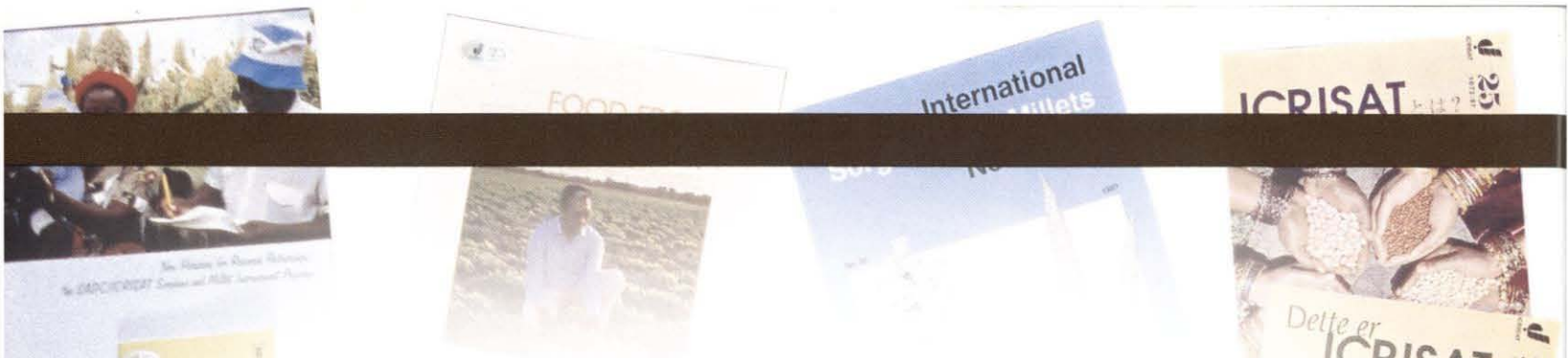

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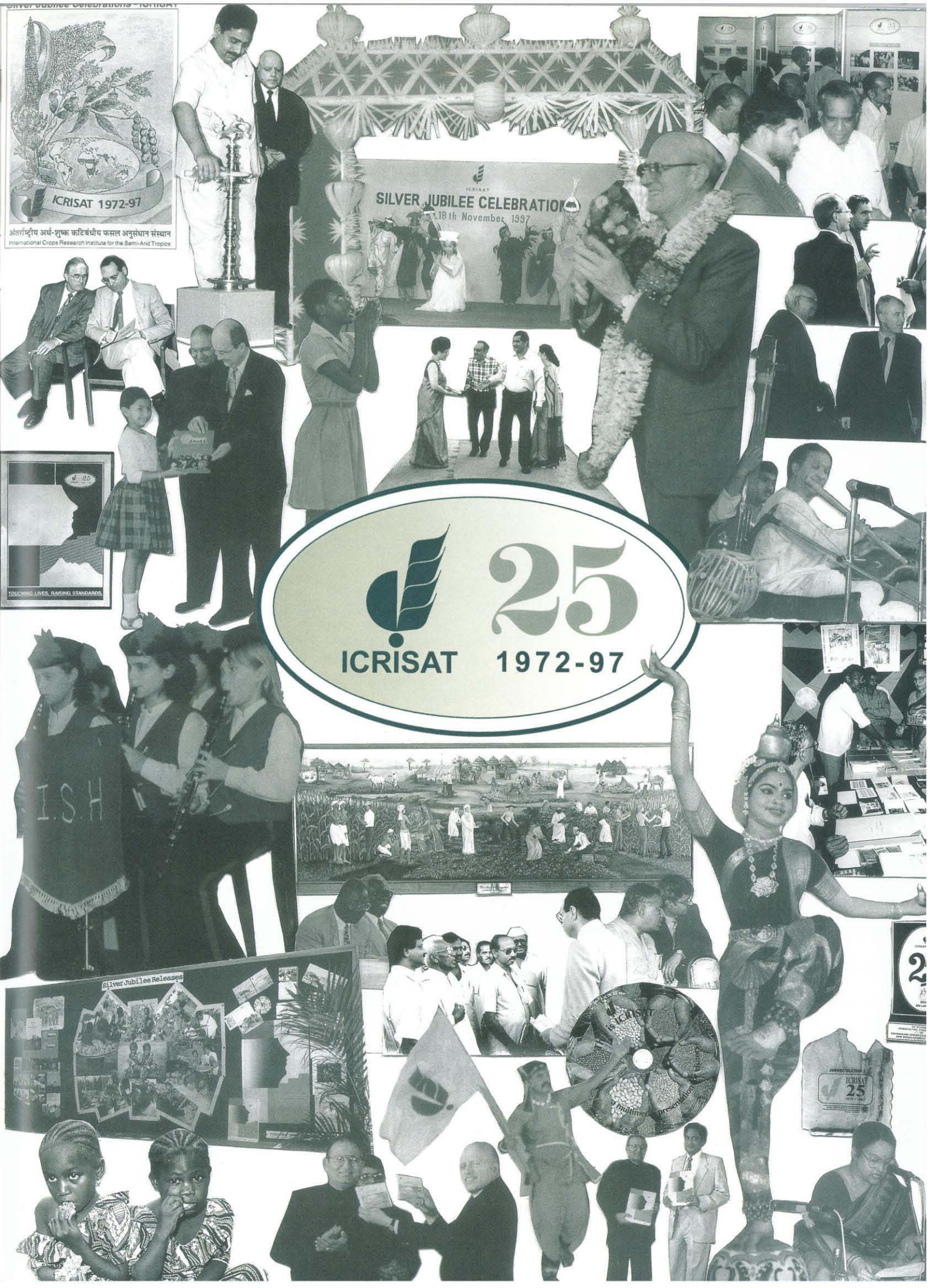
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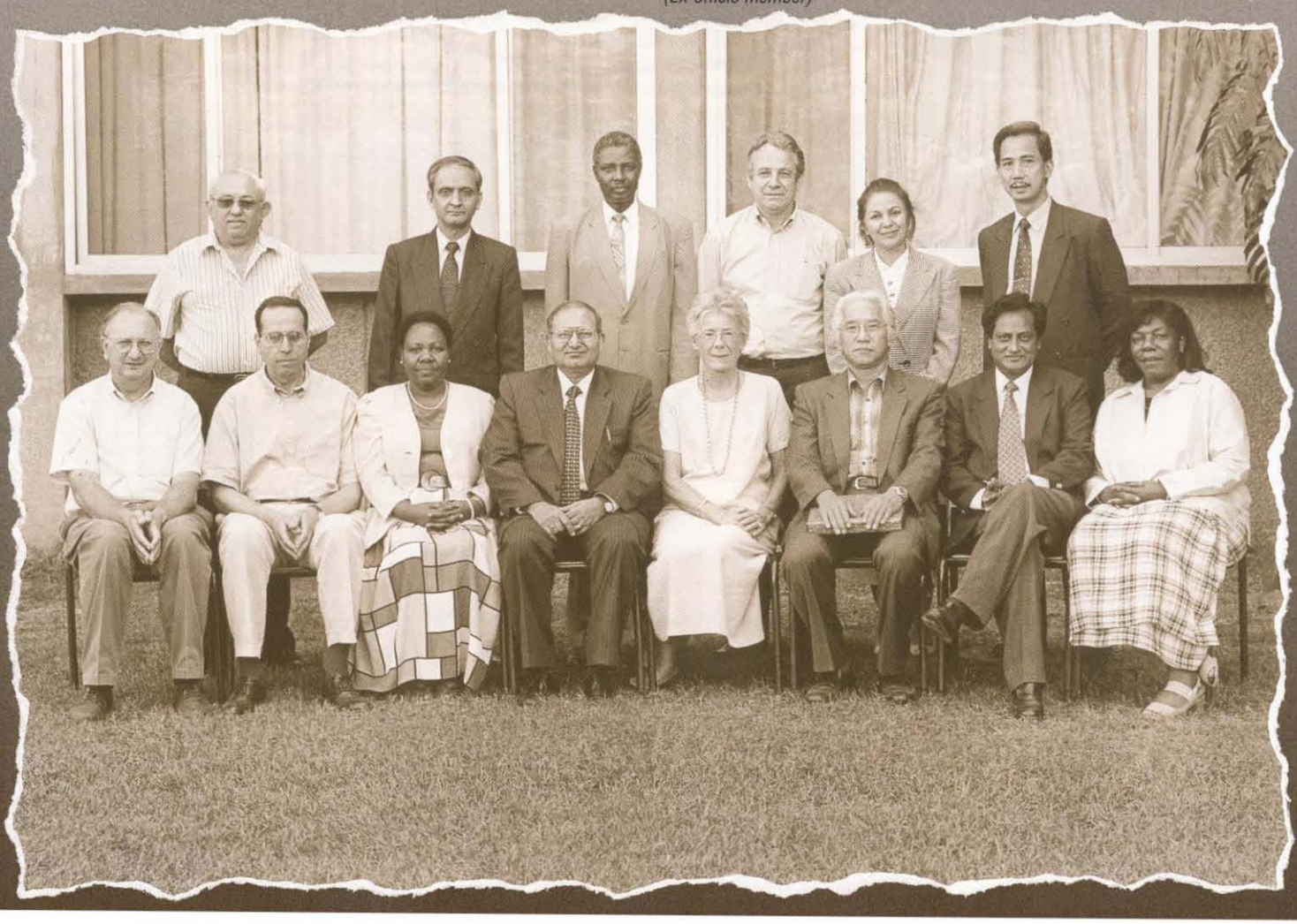

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D D Rohrbach, *USA*, ***Bulawayo***

Human Resources and Administration

N P Rajasekharan, *India*, ***Patancheru***
C Geetha, *India*, ***Patancheru***

Human Resource Management

S K Dasgupta, *India*, ***Patancheru***
R G Padhye, *India*, ***Patancheru***
A J Rama Rao, *India*, ***Patancheru***

Locations Administration

M Chakwera, *Malawi*, ***Lilongwe***
M S Diolombi, *Niger*, ***Niamey***
M Konare, *Mali*, ***Bamako***
N S Katuli, *Tanzania*, ***Bulawayo***
P Ndichu, *Kenya*, ***Nairobi***
G A Olaopa, *Nigeria*, ***Kano***

Finance

K Akuffo-Akoto, *Ghana*, ***Patancheru***
S Sethuraman, *India*, ***Patancheru***
V S Swaminathan, *India*, ***Patancheru***
T K Srinivasan, *India*, ***Patancheru***
I Tapela, *Zimbabwe*, ***Bulawayo***

Purchase, Supplies, and Disposal

M S R Chandrudu, *India*, ***Patancheru***
D K Mehta, *India*, ***Patancheru***
M Mahamane, *Niger*, ***Niger***

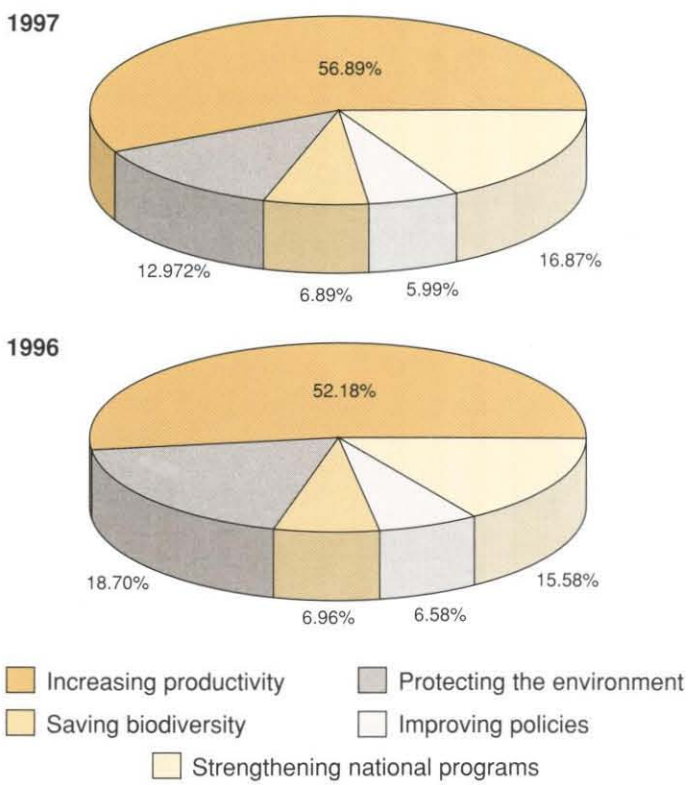
FINANCIAL SUMMARY 1997

Balance Sheet

(US$ thousands)

	1997	1996
Assets		
Cash and cash equivalents	10,342	12,011
Accounts receivable	9,302	7,113
Inventories	1,283	1,618
Prepaid expenses	231	295
Fixed assets - net	44,234	47,038
Other assets	662	781
Total assets	66,054	68,856
Liabilities		
Bank overdraft	78	103
Accounts payable	2,596	3,139
Accruals and provosions	1,377	1,426
Payments in advance from donors	6,003	2,848
In-trust funds	125	5
Long-term liabilities	7,500	6,450
Total liabilities	17,679	13,971
Net Assets	48,375	54,885
Represented by:		
Capital invested in fixed assets	44,234	47,038
Capital Fund	4,381	7,357
Operating Fund	(579)	167
Special Purpose Fund	339	323

Agreed agenda and non-agenda costs by CGIAR undertaking

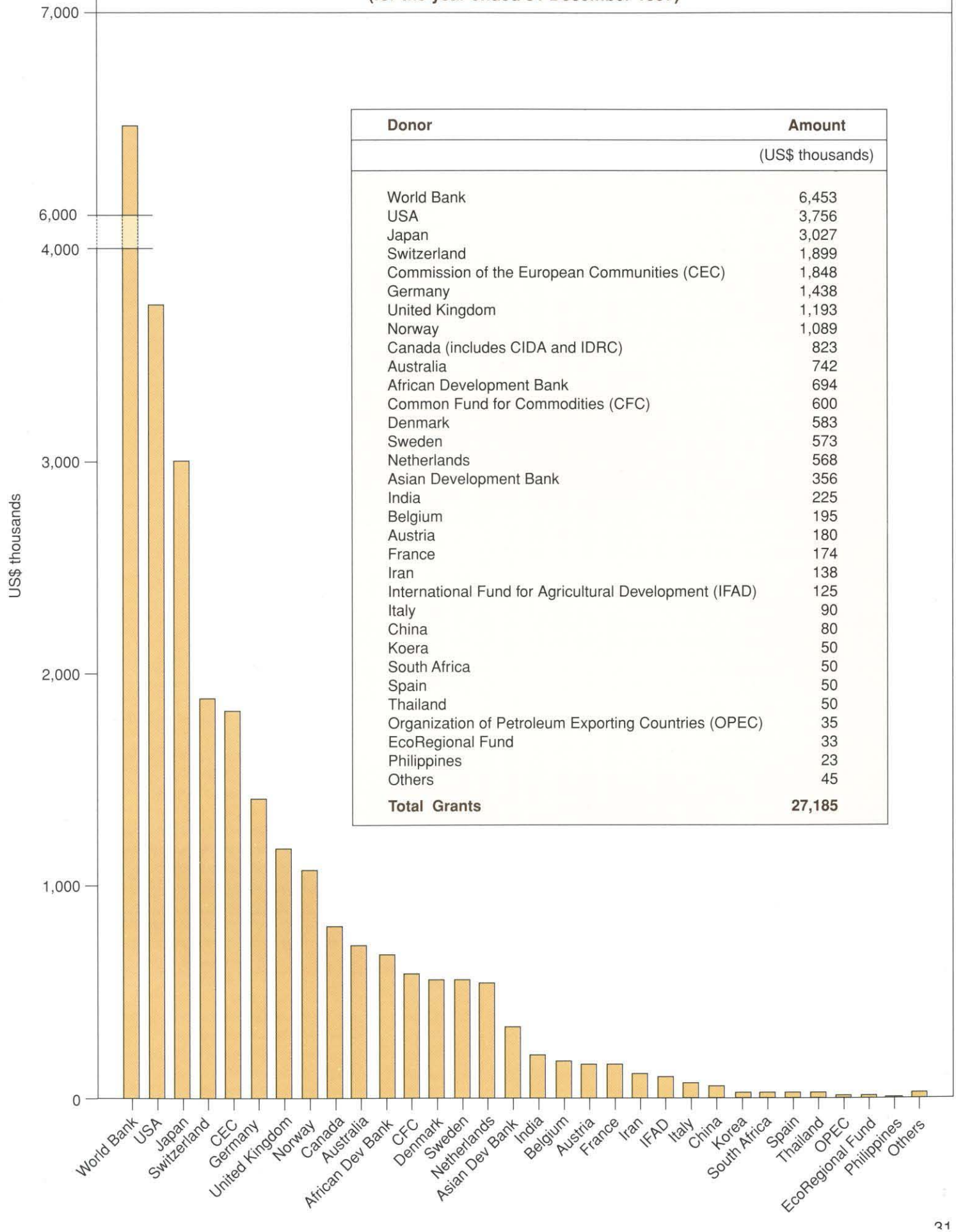


Operating results and movements on Operating and Capital Funds

(US$ thousands)

	1997	1996	Variance on 1996 increase (decrease)
Operating results			
Revenue	27,895	30,271	(2,376)
Operating expenditure	27,153	32,146	(4,993)
Operating surplus / (deficit) before unusual items	742	(1,875)	2,617
Unusual items	(254)	(625)	371
Operating surplus / (deficit)	488	(2,500)	2,988
Operating Fund			
Opening balance	167	(1,022)	1,189
Surplus / (deficit) for the year	488	(2,500)	2,988
Employee separation costs	(5,789)		(5,789)
Transfer from Capital Fund	5,000	3,732	1,268
Previous years adjustments (net)	(445)	(43)	(402)
Closing balance	(579)	167	(746)
Number of days expenditure excluding depreciation	—	2	
Capital Fund			
Opening balance	7,357	12,367	(5,010)
Depreciation charge	2,797	2,718	79
Transfer to Operating Fund	(5,000)	(3,732)	(1,268)
Net capital additions	(773)	(3,996)	3,223
Closing balance	4,381	7,357	(2,976)

Grant income from agreed agenda and non-agenda donors (for the year ended 31 December 1997)



Donor	Amount
	(US$ thousands)
World Bank	6,453
USA	3,756
Japan	3,027
Switzerland	1,899
Commission of the European Communities (CEC)	1,848
Germany	1,438
United Kingdom	1,193
Norway	1,089
Canada (includes CIDA and IDRC)	823
Australia	742
African Development Bank	694
Common Fund for Commodities (CFC)	600
Denmark	583
Sweden	573
Netherlands	568
Asian Development Bank	356
India	225
Belgium	195
Austria	180
France	174
Iran	138
International Fund for Agricultural Development (IFAD)	125
Italy	90
China	80
Koera	50
South Africa	50
Spain	50
Thailand	50
Organization of Petroleum Exporting Countries (OPEC)	35
EcoRegional Fund	33
Philippines	23
Others	45
Total Grants	**27,185**

ACRONYMS

ACIAR	Australian Centre for International Agricultural Research
AICRIP	All India Coordinated Rice Improvement Project
AME	Agriculture, Man, Ecology (India)
ANGRAU	Acharya N G Ranga Agricultural University, India (formerly APAU)
APSIM	Agricultural Production Systems Simulator (Australia)
APSRU	Agricultural Production Systems Research Unit (QDPI and CSIRO, Australia)
ARC-NSW	Australian Research Council, New South Wales (Australia)
AUA	Alemaya University of Agriculture (Ethiopia)
AVRDC	Asian Vegetable Research and Development Center (Taiwan)
BARC	Bhabha Atomic Research Centre (India)
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (Germany)
CABI	Centre for Agriculture and Biosciences International (UK)
CARMASAT	Collaboration on Agricultural Resource Modeling and Applications in Semi-Arid Tropics
CAZRI	Central Arid Zone Research Institute (India)
CCMB	Centre for Cellular and Molecular Biology (India)
CCS HAU	Chaudhary Charan Singh Haryana Agricultural University (India)
CEC	Commission of the European Communities (Belgium)
CENARGEN	Centro Nacional de Pesquisa de Recursos Genéticos e Biotecnologia (Brazil)
CFC	Common Fund for Commodities (Netherlands)
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro International de Agricultura Tropical (Colombia)
CIDA	Canadian International Development Agency
CIMMYT	Centro Internacional de Mejoramiento de Maïz y Trigo (Mexico)
CIP	Centro Internacional de la Papa (Peru)
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement (France)
CLAN	Cereals and Legumes Asia Network
CNEARC	Centre national d'etudes agronomiques desregions chaudes (France)
CORAF	Conférence des responsables de la recherche agronomique africains (Senegal)
CRIDA	Central Research Institute for Dryland Agriculture (India)
CSIR	Council of Scientific and Industrial Research (India)
CSIR-Foodtek	Council for Scientific and Industrial Research (South Africa)
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
CWS	Centre for World Solidarity (India)
DANIDA	Danish International Development Agency
DDS	Deccan Development Society (India)
DFID	Department for International Development, UK (formerly ODA)
DMP	Desert Margins Program
DOA	Department of Agriculture
EEA-INTA	Estación Experimental Agro-Industrial "Obispo Colombres" - Instituto Nacional de Tecnologia Agropecuaria (Argentina)
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária (Brazil)
FAO	Food and Agriculture Organization of the United Nations (Italy)
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (Germany)
IADB	Inter-American Development Bank
IAR	Institute for Agricultural Research (Nigeria)
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
ICARDA	International Center for Agricultural Research in the Dry Areas (Syria)
ICIMOD	International Centre for Integrated Mountain Development (Nepal)
ICIPE	International Centre of Insect Physiology and Ecology (Kenya)
ICRAF	International Centre for Research in Agroforestry (Kenya)
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)
IFPRI	International Food Policy Research Institute (USA)
IGER	Institute of Grassland and Environment Research (UK)
IITA	International Institute of Tropical Agriculture (Nigeria)
ILRI	International Livestock Research Institute (Ethiopia and Kenya)
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)
IPGRI	International Plant Genetic Resources Institute (Italy)
IRRI	International Rice Research Institute (Philippines)
ISNAR	International Service for National Agricultural Research (Netherlands)
JIRCAS	Japan International Research Center for Agricultural Sciences
MAFF	Ministry of Agriculture, Forestry, and Fisheries (Japan)
MANAGE	National Institute of Agricultural Extension Management (India)
NAARM	National Academy of Agricultural Research Management (India)
NARO	National Agricultural Research Organization (Uganda)
NARS	National Agricultural Research Systems
NBPGR	National Bureau of Plant Genetic Resources (India)
NBSS&LUP	National Bureau of Soil Survey and Land Use Planning (India)
NCAER	National Council of Applied Economic Research (India)
NCAP	National Centre for Agricultural Policy Research (India)
NCBS	National Centre for Biological Sciences (India)
NCL	National Chemical Laboratory (India)
NDOR	National Directorate of Oilseeds Research (India)
NGO	Non-Governmental Organization
NIN	National Institute of Nutrition (India)
NRCG	National Research Centre for Groundnut (India)
NRCS	National Research Centre for Sorghum (India)
NRI	Natural Resources Institute (UK)
NRSA	National Remote Sensing Agency (India)
ODI	Overseas Development Institute (UK)
OPEC	Organization of Petroleum Exporting Countries (Austria)
OPI	Oil Plant Institute (Vietnam)
ORSTOM	Institut français de recherche scientifique pour le développement en coopération (France)
PAU	Punjab Agricultural University (India)
PCARRD	Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development
Peanut CRSP	Peanut Collaborative Research Support Program (USA)
PIG	Particle Inflow Gun
PROCELOS	Promotion des céréales locales (Mali)
QDPI	Queensland Department of Primary Industries (Australia)
QTL	Quantitative Trait Loci
RAU	Rajasthan Agricultural University (India)
RDT	Rayalaseema Development Trust (India)
ROCAFREMI	Réseau ouest et centre africain de recherche sur le mil (Niger)
ROTAPHOS	Rotation and Phosphorus
RWC	Rice-Wheat Consortium for the Indo-Gangetic Plains
SADC	Southern African Development Community (Botswana)
SAFIRE	Southern Alliance for Indigenous Resources (Zimbabwe)
SARI	Savarna Agricultural Research Institute (Ghana)
SCRI	Scottish Crop Research Institute (UK)
SDC	Swiss Agency for Development and Cooperation
SPALNA	Soil and Plant Analytical Laboratories Network of Africa (Nigeria)
TIFR	Tata Institute of Fundamental Research (India)
UAS	University of Agricultural Sciences (India)
UGA	University of Georgia (USA)
UH	University of Hohenheim (Germany)
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VUB	Vrije Universiteit Brussel (Belgium)
WARDA	West Africa Rice Development Association (Côte d'Ivoire)

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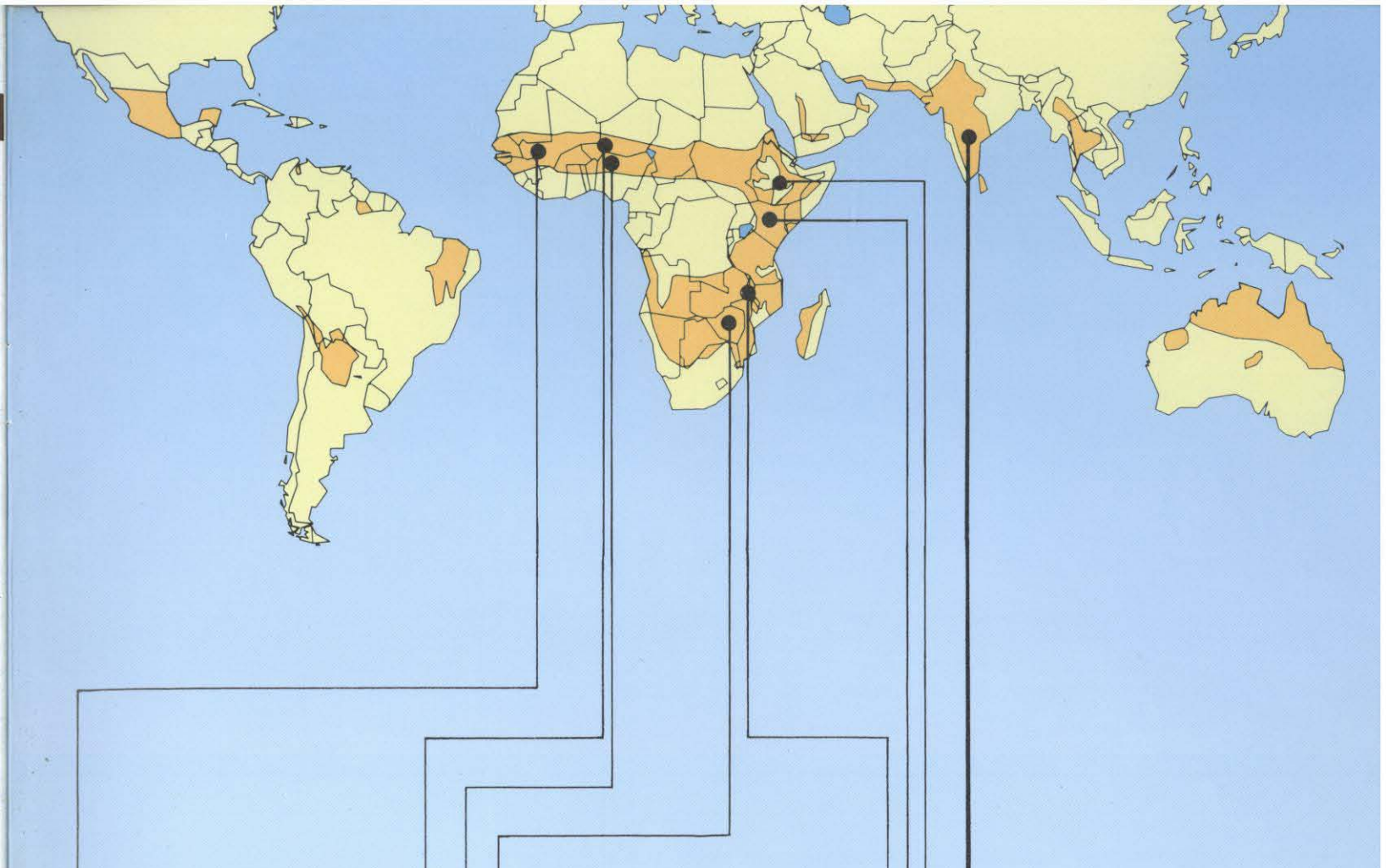

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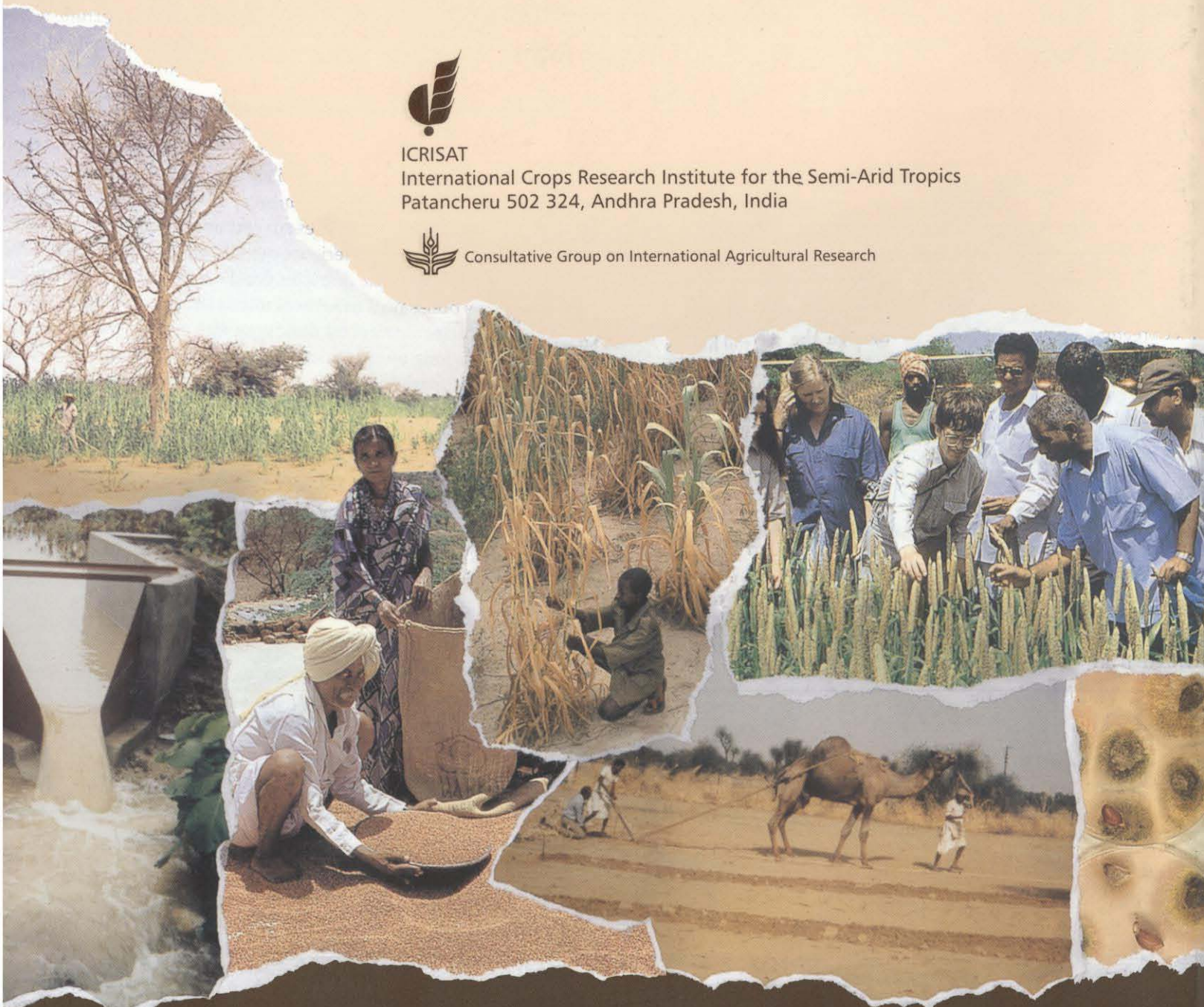
Consultative Group on International Agricultural Research



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