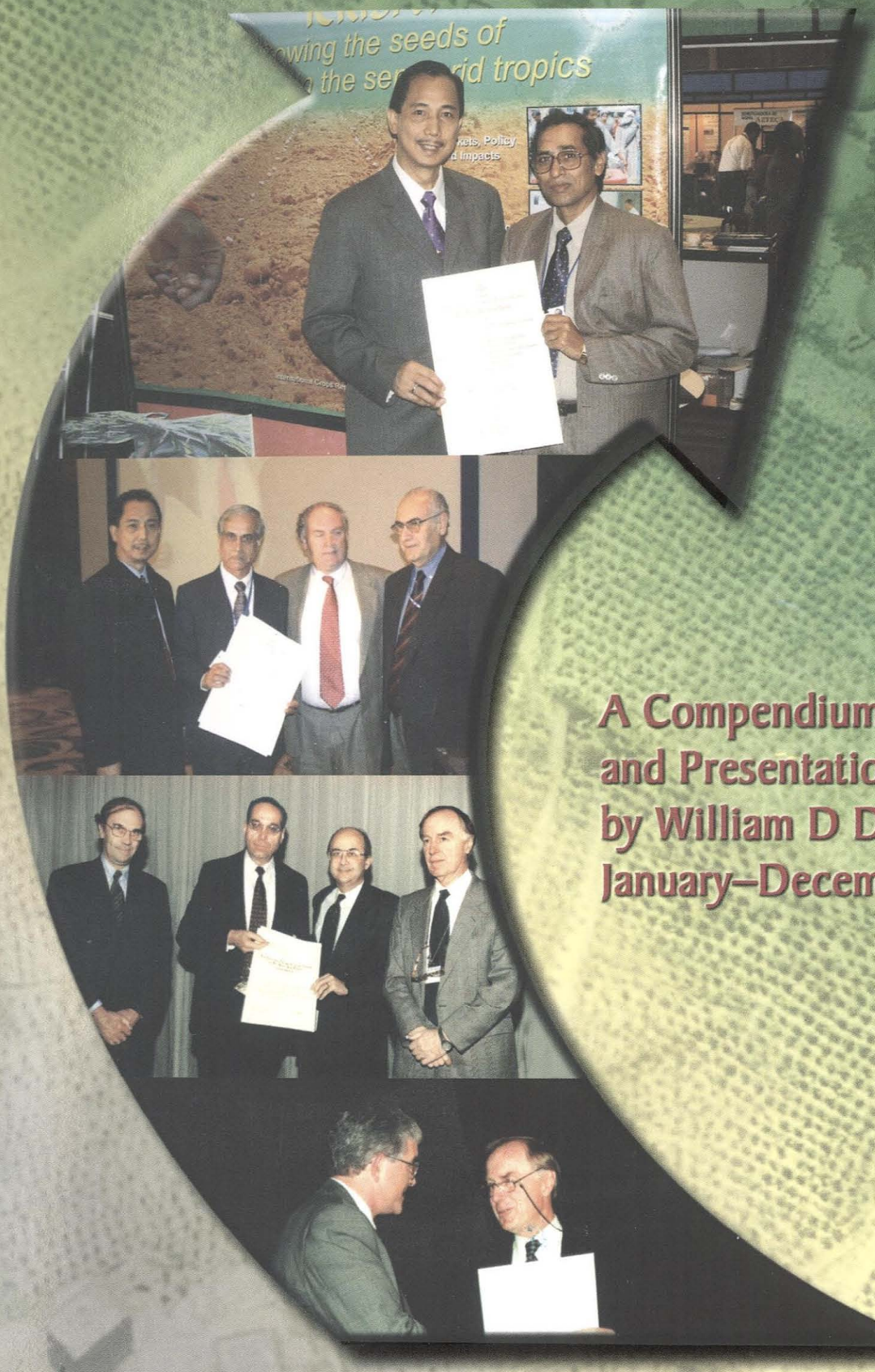
ICRISAT's Turnaround:

Strategic partnerships for impact



A Compendium of Speeches and Presentations by William D Dar January–December 2004

International Crops Research Institute for the Semi-Arid Tropics

ICRISAT's Turnaround:

Strategic Partnerships for Impact

A Compendium of Speeches and Presentations by William D Dar

January–December 2004

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

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Speeches

William D Dar

Director General, ICRISAT

Biographical Sketch

William D Dar is Director General of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) near Hyderabad in Andhra Pradesh, India, since January 2000. ICRISAT is one of 15 nonprofit, nonpolitical centers under the umbrella of the Consultative Group on International Agricultural Research (CGIAR).

Dr Dar now has the distinction of being the first Filipino to be Chairman of the Alliance of Future Harvest Centers, an international body that governs the collective functioning of individual CGIAR centers. Dr Dar is a Member of the UN Millennium Task Force on Hunger. Prior to joining ICRISAT, he served as Presidential Advisor for Rural Development, and Secretary of Agriculture in the Philippines (equivalent to Minister of Agriculture), the first ever alumnus of the University of the Philippines Los Baños (UPLB) to become one. Before this, he was Executive Director of the Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD) and Director of the Bureau of Agricultural Research (BAR) of the Philippine Department of Agriculture (DA). He also served on the managing boards of the Australian Center for International Agricultural Research (ACIAR) and the CGIAR's International Maize and Wheat Improvement Center (CIMMYT) as well as of ICRISAT. Moreover, he was Chair of the Asia-Pacific Association of Agricultural Research Institutions (APAARI) and the Coarse Grains, Pulses Research and Training (CGPRT) Center based in Indonesia.

Dr Dar received a Doctor of Philosophy (Ph.D.) in horticulture from the University of the Philippines Los Baños and an M.S. (Agronomy) and B.S. in agricultural education from Benguet State University (BSU) in La Trinidad, Benguet, Philippines. He taught at BSU for 11 years and rose from the ranks to become full Professor and Vice President for Research and Extension.

He has received a number of awards and honors – Ten Outstanding Young Men (TOYM) of the Philippines, Outstanding Young Scientist of the Year, Crop Science Society of the Philippines' Achievement Award for Research Management and Outstanding Science Administrator given by the Philippines Department of Science and Technology. He was also honored as Distinguished Alumnus of UPLB and Most Outstanding Alumnus of BSU. In November 2002, PCARRD bestowed upon him its highest and most prestigious award, the Symbol of Excellence in R&D Management. In April 2003, Dr Dar was conferred the honorary degree of Doctor of Science by the Mariano Marcos State University (MMSU) in Batac, Ilocos Norte, Philippines. In October 2003, the Vietnamese Government honored Dr Dar with the 'For the Sake of Agriculture and Rural Development in Vietnam Award' while the Philippine Bureau of Agricultural Research awarded him with a Plaque of Recognition for his outstanding performance as its First Director. He is also the recipient of the "Anahaw Leaf Award' for being the Most Outstanding Alumnus of the Ilocos Sur Polytechnic State College (ISPSC) High School Class of '69. In April 2004, the Central Luzon State University in the Philippines awarded him the Golden Grain Award, commending him for his "deep concern and intense advocacy for the promotion of a global yet equitable program for food security and reduction of poverty through pioneering scientific and technological innovations".

Since leading ICRISAT, he has intensively advocated a *Grey to Green Revolution* in the dry tropics of Asia and sub-Saharan Africa through *Science with a Human Face*. Towards this, he spurred the development of a new vision, mission and strategy for the Institute.

In pursuing the new vision, mission and strategy, he has strengthened strategic partnerships with an array of

stakeholders – NARS, ARIs, NGOs, development agencies and the private sector. These initiatives led to a stronger ICRISAT working for a food-secure SAT.

In 2004, ICRISAT led by Dr Dar, won for the fourth time the King Baudouin Award (the most prestigious in the CGIAR) together with CIMMYT, IRRI, IWMI and other national systems in the CIMMYT-led Rice-Wheat Consortium for the Indo-Gangetic Plains. Earlier in 2002, again under his leadership, the Institute together with ICARDA had bagged the award for developing new chickpea varieties with higher tolerance to drought and heat, greater resistance to pests and diseases and that provide stable and profitable yields. ICRISAT is the only CGIAR Center to have bagged this award four times. In 2003, ICRISAT underwent two external reviews from the CGIAR, acknowledging outstanding science quality and sound management under Dr Dar. These reviews gave the impetus for ICRISAT to carve out a new strategy for its transformation and renewal as a premier center of scientific excellence for the people of the dry tropics in the 21st century. In the same year, ICRISAT stood second among the 15 CGIAR Centers in terms of financial health indicators developed by the World Bank. The turnaround for the Institute was possible because of his effective and human-oriented leadership. As a demonstration of the strong faith in his leadership in turning ICRISAT around, the Governing Board awarded Dr Dar a new five-year term starting January 2005.

Foreword

ICRISAT's Turnaround: Strategic Partnerships for Impact is the 5th compendium of speeches delivered by Dr William D Dar, Director General, ICRISAT, that embodies an impressive account of well guided change triggered by the reorientation of institutional agenda.

Food insecurity, hunger and malnutrition afflict about half the population in sub-Saharan Africa (SSA). As of 2004, the SSA region is far from achieving its Millennium Development Goals (MDGs) of reducing by half both the proportion of people, about 325 million in 23 countries, living on less that US$1 per day and people who suffer from acute hunger. With a contribution of nearly 20% towards GDP and 60% of the labor force engaged in agriculture, the sector remains at the core of development in the region. Therefore, agricultural research aimed at generation of relevant technologies is an imperative. The challenge may appear to be very daunting but certainly not insurmountable.

The speeches of Dr Dar cover diverse issues ranging from how ICRISAT shifted its focus to stay in tune with the times; its new Vision and Strategy – 2010; its answer to the challenges facing agriculture in SSA to resource generation; enhanced partner power and other issues crucial to agricultural development. Some of his speeches, especially the ones delivered at the University of Philippines Los Banõs alumni reunion and the anniversary of the Benguet State University, clearly highlight as to how ICRISAT under the dynamic leadership of Dr Dar could evolve as an institution with a force to reckon with.

I would recommend this compendium as a valuable source of information on the rapid strides ICRISAT is making in transforming agriculture in sub-Saharan Africa and Asia. It is a judicious mix of facts and figures, home truths and advice, issues and solutions.

(MANGALA RAI)
Secretary (DARE) & Director-General ICAR
Ministry of Agriculture
Krishi Bhavan, New Delhi - 110001

Transforming BSU into a Premiere Institution of Higher Learning

Speech delivered during the 17th anniversary of the Benguet State University, 12 January 2004, Benguet, Philippines

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My dear colleagues at BSU, good evening!

Allow me to express how happy I am being with you again today. I must reiterate that BSU will always be my home.

First of all, I take this opportunity to congratulate Dr Rogelio D Colting, our president at BSU. Coming from your own ranks, I enjoin all of you to support him and give your best in transforming BSU into a premiere institution of higher learning in the Cordilleras and the whole country.

I am happy to note that an institutional review of the University was conducted at the onset of Dr Colting's presidency. The results of the review will be very useful in helping him map out cutting edge reforms to reinvent BSU.

As for ICRISAT, I am happy to inform you that we too have overcome two external reviews recently. These two reviews bear out the high quality of science and its sound management at ICRISAT. Results of the external reviews provided the impetus to transform ICRISAT into a world center of scientific excellence in dryland agriculture.

The reforms at BSU are indeed very well timed. During the seventies, the Philippines was one of Asia's leading education centers. Over the years, the quality of education has significantly declined at all levels. In higher education, this is supported by the *Asiaweek* survey of the 80 top-ranking

regional universities. Sadly, our premier national university, the University of the Philippines, ranks only 44th. Average passing rates in the annual professional licensure examinations too are low, averaging only around 45%. The pervasive low quality of higher education does not augur well for the country's rapid economic growth.

Reforms are therefore imperative to address the low quality of and inefficiency in higher education. First, the skills and competencies of our graduates must be upgraded to prepare them for productive work in the domestic and global labor markets. Second, our faculty must be imbued with a passion for academic excellence, highest standards of values and virtues, and at the same time keep abreast of global changes. And third, reform is necessary to enable our tertiary education system to accommodate the ever-increasing number of high school graduates.

In transforming itself, BSU must pursue the vision of higher education, which is to provide and expand opportunities to develop the technological knowledge and skills of Filipinos. We must not lose sight of the fact that higher education aims to improve our ability to think critically, act positively and contribute to the all round development of the family, community and larger society.

BSU should also accelerate the development of high-level professionals who will search for new knowledge and provide leadership in the various disciplines required by a dynamic and self-sustaining economy.

Higher education can also be used to harness the productive capacity of our country's human resource base towards international competitiveness. At this juncture, let me digress a bit to speak on two global issues that concern us all: hunger and food insecurity.

"We must not lose sight of the fact that higher education aims to improve our ability to think critically, act positively and contribute to the all round development of the family, community and larger society."

As of today, the world is not on track in fulfilling its pledge of attaining food security. During the last decade, the number of food-insecure people in the developing world fell by just 2%, or barely 2.5 million per year. If we exclude China, the number actually *increased* by over 50 million people!

The causes of hunger are complex, and include violent conflict, environmental factors and discrimination based on gender, ethnicity, age and other factors. The fundamental cause of hunger, however, is poverty. People are hungry because they cannot afford to buy all the food they need, and they lack the land and other resources necessary to produce food for themselves.

According to our sister center, the International Food Policy Research Institute (IFPRI), action is vital in seven key areas if we are to reduce hunger.

First, we need to invest in human resources — access to health, education, clean water and safe sanitation for all. Note that IFPRI has found that *educating girls as well as boys has a huge impact in reducing hunger.* Improvement in education of girls accounted for over 40% of the decline in child malnutrition levels between 1970 and 1995.

Second, given the gravity of hunger and poverty, broad-based agricultural and rural development is essential to attain food security, for these boost not just the income of the rural poor but also spur growth in developing countries where a bulk of the workforce is engaged in agriculture.

Third, investment in human resources and access of the poor to productive resources must be synchronized with access to markets, infrastructure and support institutions. Investment in infrastructure is essential to connect poor people to markets.

Fourth, it is essential to expand research, knowledge and technology that is relevant in solving the problems of poor farmers and consumers in developing countries. New developments in molecular biology and information and communication technology hold great promise in improving food security.

Fifth, we need to improve the management of the natural resource base upon which agriculture and food security depend, including land, water, trees and biodiversity. Otherwise, hunger will affect future generations. When poor farmers have secure ownership, they are more likely to engage in sustainable management practices.

Sixth, the current round of global agricultural trade negotiations must result in a fair set of rules for poor countries. At present, developed countries, including the United States and the European Union, provide trade-distorting subsidies to their own agricultural sectors. They also impose tariff barriers on developing country exports that escalate with the value of the product.

Seventh, and probably the most important, is good governance. This includes the rule of law, transparency, eliminating corruption, sound public administration and respect for human rights. The lack of progress in reducing global hunger in the past decade is related to the greater number of political conflicts and wars. In short, failure in governance, hunger and war are very much interrelated.

As I close, let me reiterate as I did last year that ICRISAT is an organization that serves people first and foremost. Quality science is only a means for us to serve the poor, not an end in itself. Hence, even if we do excellent research, but do not make an impact on the poor, we will have failed.

Only by mobilizing science to help poor countries reduce poverty, malnutrition and environmental degradation, can we ensure that we have made a big difference. We therefore tailor our research programs to meet real human needs: reducing poverty, hunger, environmental degradation and social inequity.

This is the human face of the science and agricultural research that we do. It is the guiding light of our efforts and the paramount theme of our endeavors at ICRISAT.

I therefore urge BSU to embrace *Science with a human face* as its core value in catalyzing sustainable development in our country. In doing this, ICRISAT will be your partner and ally.

Thank you and good evening.

Macro Benefits from Micronutrients: Winning the Grey to Green Revolution

Inaugural address at the IFA International Symposium on Micronutrients, 23 February 2004, New Delhi, India

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Allow me to thank the organizers of this symposium for giving me the honor of addressing this prestigious event. I speak on behalf of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), a non-profit, non-political, international agricultural research organization. Established in 1972, ICRISAT is one of 15 centers under the umbrella of the Consultative Group on International Agricultural Research (CGIAR).

ICRISAT's vision is the improved well-being of the poor of the semi-arid tropics (SAT) through agricultural research for impact. We are committed to helping the poor of the semi-arid tropics through *Science with a human face* and partnership-based research to increase agricultural productivity and food security, reduce poverty and protect the environment in the drylands.

Basically, we work to improve and sustain agricultural productivity in some of the harshest environments, accounting for about two-thirds of the world's cultivable land. We serve more than 800 million people, the poorest of the poor who live in the dry areas of 48 countries spanning Asia and sub-Saharan Africa.

Soils in the semi-arid tropics have very low fertility and are degraded to varying degrees. The SAT has undependable rainfall, high temperatures and very scarce water. The drylands are densely populated, and most of its people live through subsistence agriculture.

The Green Revolution in Asia bypassed these large tracts of rainfed lands. That is why ICRISAT is committed to helping improve livelihoods in the drylands by launching a Grey to Green Revolution. Together with our partners, integrated genetic and natural resource management (IGNRM) for watersheds is our major weapon for winning the Grey to Green Revolution.

Through IGNRM, we work with our partners to increase food production, nutrition, and make it affordable for the poor of the drylands. We also develop options to diversify the utilization of staple food crops. Likewise, we design tools and techniques to manage risk and utilize the natural resource base in a sustainable fashion. Through these, we aim to minimize land degradation, develop options to diversify cropping systems and identify sources for income generation. At the same time, we strengthen delivery systems to our stakeholders. In short, partnership-based research, gender sensitivity, capacity building and enhanced technology sharing are integral to our approach.

Since water shortage is a key constraint to sustained increased productivity in the SAT, we developed an innovative consortium model for watershed management, wherein the emphasis shifted from mere soil and water conservation to efficient utilization of resources by converging activities in the watershed. Thus, watershed management is being used as an entry point to improve livelihoods.

Apart from water shortage, low fertility is also a major constraint to agriculture in the SAT. Hence, the soils are not just thirsty, they are hungry too. The hidden hunger often goes unnoticed. Therefore, better availability and utilization of water along with integrated nutrient management are the keys in helping farmers in the SAT. This will significantly draw them out of the vicious circle of low productivity, low incomes and increased land degradation. It may be recalled that it was a

"Together with our partners, integrated genetic and natural resource management (IGNRM) for watersheds is our major weapon for winning the Grey to Green Revolution."

combination of high-yielding varieties, adequate nutrients and optimum water supply that paved the way for the Green Revolution.

While the greater use of inorganic fertilizer dramatically increased food production during the Green Revolution, it also depleted micronutrient reserves in the soil. This resulted in a number of nutrient disorders and associated nutrient imbalances. A sharp decline in the available micronutrient status of soils is reported in irrigated agricultural production systems in India. My paper provides you with a unique account of severe deficiencies in micro and secondary nutrients in drylands, and also a way forward to achieve a Grey to Green Revolution.

Indian soils have been under intensive cultivation for hundreds of years; micronutrient deficiencies are therefore not surprising. However, in the case of irrigated systems, deficiencies have appeared gradually as they were monitored by soil and plant analyses. So micronutrient deficiencies were anticipated.

Micronutrients have also dwindled in dryland agriculture in the recent past due to continued cropping coupled with the use of micronutrient-free fertilizers. Our baseline studies in the three States of Andhra Pradesh, Madhya Pradesh and Rajasthan in India have revealed that the SAT's subsistence agricultural systems have depleted soils beyond critical limits not only in terms of macronutrients but also micronutrients such as zinc and boron, and secondary nutrients such as sulphur. Widespread (80-100%) deficiencies in micro and secondary nutrients were observed in these States.

Unlike irrigated production systems, monitoring micronutrients in the soil-crop system in dryland agriculture has not been carried out. Thus, the soil's hidden hunger has not been recognized. There is a need to undertake detailed soil analysis to identify specific deficiencies in micro and secondary nutrients in rainfed areas.

The evaluation and scaling-up of new farmer participatory models in community watersheds by ICRISAT and its partners enabled us to study the role of water harvesting and utilization

practices. The IGNRM approach adopted in our watershed program uses water as an entry point to improve livelihoods through increased and sustained productivity of drylands. Our studies in selected districts of three States of India and parts of northern Vietnam have revealed the tremendous potential of micronutrients in increasing the productivity of dryland crops. A large number of farmers reported substantial yield increases ranging from 20 to 80% due to micronutrient amendments in a number of crops (maize, sorghum, greengram, pigeonpea, castor, chickpea, soybean and wheat). Further, benefits from the application of micronutrients rose by 70-120% when recommended N and P fertilizers were also applied to these crops. Chickpea and wheat grown after the rainy season crop benefited largely through the residual benefits of the micronutrients applied to previous crops. In Madhya Pradesh, chickpea yields increased by 48-75% through residual benefits of micronutrients applied to soybean. Farmers' incomes as well as rainwater use efficiency (RUE) in dryland areas substantially increased due to micronutrient amendments. An additional net profit of US$190 per ha was obtained by farmers in Madhya Pradesh due to the application of boron and sulphur.

Water is a very important but scarce commodity in the SAT, and all our efforts are directed towards increasing its use efficiency. Rainwater use efficiency improved by 25 to 115% in the case of soybean, maize, groundnut, mungbean and sorghum in different regions. In terms of economic returns for rainfed crops, RUE was substantially higher by 1.5 to 1.75 times in micronutrient-amended fields.

My paper (see page 11) gives detailed results of case studies on potential micronutrient deficiency in the three States of India. Here, the effect of applying micronutrients on crop yields in farmers' fields illustrates the important role micronutrients play in increasing production and productivity of dryland crops. Moreover, harnessing rainfall together with micronutrients proved very useful in improving crop productivity in the drylands.

In conclusion, I repeat that there is need to monitor micronutrient status through analyses of soil and plant tissue in farmers' fields. Since farmers are unaware of the hidden

hunger, there is an urgent need to ensure that each farmer knows the health of his soil in order to ensure sustainable development of agriculture. It is clear that micronutrients are indeed playing a macro role in augmenting crop yields, not only under irrigated agriculture, but also in the drylands. We can substantially increase fertilizer (N and P) as well as rainwater use efficiency by supplying the fast-depleting micro and secondary nutrients even under subsistence agriculture in order to achieve a Grey to Green Revolution. Micronutrients and secondary nutrients are as important as macronutrients, water and improved varieties.

In IGNRM, we improve the quality and sustainability of the soil, facilitating synergy between genetic tolerance and plant nutrition through improved soil and water conservation practices. Using community watersheds as our entry point, IGNRM is helping us win the Grey to Green Revolution in the drylands. Let me conclude with a plea to you all to join hands with us in improving dryland agriculture and in making the Grey to Green Revolution a reality.

Thank you and good day.

Managing Drought: Lessons from the APRLP-ICRISAT Project

Inaugural address for the National Workshop on Drought Management Strategies: Lessons from the APRLP-ICRISAT Project, 18 March 2004, ICRISAT, Patancheru, Andhra Pradesh, India

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Ladies and gentlemen, good morning.

Let me extend my warmest welcome to all of you at ICRISAT at this workshop on drought management focusing on the lessons we learned from the APRLP-ICRISAT project.

I would like to extend a special welcome to Mr Harinarayan, Secretary, Ministry of Rural Development, Government of India; Mr M Samuel, Principal Secretary, Rural Development, Government of Andhra Pradesh; Mr Anil Punetha, Commissioner, Rural Development, Government of AP and a friend of ICRISAT; Mr SP Tucker, Project Coordinator; Mr Sanjay Gupta, Commissioner; and Mrs TK Sreedevi, Project Coordinator.

I also warmly welcome Dr Balaji Singh from USAID. Let me also acknowledge our strong partners Dr Ramakrishna, Director, CRIDA, and his team comprising Dr Padma Raju, Director, Research; and Dr Satyanarayana, Director, Extension; the ANGRAU team; scientists from the NRSA; Directors, District Water Management Agency; NGO partners and our most important partners, the farmers.

We also have Dr VD Patil, Director, Soil and Water Conservation, Maharashtra, and participants from Maharashtra, Karnataka,

Madhya Pradesh and Rajasthan among us. Some of you are visiting ICRISAT for the first time; so I would suggest that you take advantage of our environment-friendly ambience in the campus.

This workshop is part of our continuing series of drought management initiatives during the last three years. Last year, we held a brainstorming workshop on coping strategies to manage drought in partnership with APRLP and TATA Projects. This was followed by review and planning meetings for the integrated watershed management projects implemented by the consortium.

This workshop draws lessons learned from the APRLP-ICRISAT initiative. Our project is unique since for the first time, a consortium of research institutions, developmental agencies and non-government organizations are working with farmers.

It is also the first time that an ICT-enabled rural information hub is being operated by a women's association, the Adarsha Women Welfare Society at Addakal. This inspired the establishment of our Virtual Academy for the Semi-Arid Tropics (VASAT). The hub is now recognized as an e-center of the Government of Andhra Pradesh.

Recently, a World Bank team from Washington visited this hub. The team was amazed at the empowerment of its members. This is a remarkable feat in a span of two years. I congratulate all of you who have worked to make this possible.

Recently, *The Hindu* published a story with this lead: "When a big farmer, Ranga Reddy, decided to sell all his 17-acre barren stretch in this village, 65 kilometers from Hyderabad, for a paltry 1.1 lakh rupees out of sheer desperation of being unable to bring it under cultivation, he never thought it would become a

"Our project is unique since for the first time, a consortium of research institutions, developmental agencies and non-government organizations are working with farmers."

virtual goldmine commanding a price of 1 lakh rupees per acre in four years".

Many of you are aware of the Adarsha Watershed at Kothapally which has become a source of inspiration for all of us. In our project, the watershed is used as an entry point to improve livelihoods of the poor. Traditionally, watershed only signified soil and water conservation. Economic benefits from this holistic approach reveal that communities can indeed be empowered beyond dependency.

The model was developed by our partners, mainly CRIDA, NRSA, MV Foundation and DPAP, an arm of the State Government. This was made possible through the support of Mr Punetha, Mrs Sreedevi and Mrs Rani Kumudini, Collector of Ranga Reddy district.

Two years ago, the APRLP scaled-up the Kothapally model from one to 50 watersheds. This initiative has yielded very meaningful lessons that will be shared during the workshop. Without pre-empting your deliberations, let me cite some lessons:

- Demand-driven rather than supply-driven strategies should be pursued for rural development
- Productivity of rainfed systems can be increased through increased rainwater use efficiency
- Tangible and equitable economic benefits are needed for effective people empowerment
- Holistic solutions are needed to solve complex natural resource related problems
- Participation of all sectors of society, including women and landless people, in the watersheds is critical
- Technical backstopping of a consortium of partners for sustainable watershed management is indispensable.

During the workshop, we will also map out strategies to further scale-up benefits, develop institutional arrangements and identify policy support needed. We will further refine technologies based on the continuous monitoring and evaluation of pilot watersheds.

Recently, I had the opportunity to address an august gathering of renowned scientists in an international symposium on micronutrients. In my inaugural address, I spoke about macro benefits from micronutrients, focusing on the results of the APRLP watersheds. Farmers harvested 30 to 120% more yields by amending deficient micronutrients such as sulphur, boron and zinc in rainfed conditions.

The economics of and increase in rainwater use efficiency also generated a lot of interest in the symposium. Farmers harvested 32 to 150% more yields and earned Rs 2,700 to 8,200 more per hectare in 2002, which was the worst drought year. Farmers from 50 watersheds quickly replicated this technology during the 2004 cropping season.

I am sure that during the course of the workshop, you will hear about more breakthroughs from consortium partners. I would like to emphasize that we must replicate our experiences in building partnerships and mobilizing communities across the dry tropics.

Lessons generated by the APRLP-ICRISAT project must be widely shared so that through partnerships, participation and science-based technologies, we can empower people in the dry tropics to cope better with drought.

I am closely associated with watersheds since they are the entry points of Integrated Genetic Natural Resource

Management (IGNRM). After our external reviews, we have adopted IGNRM as ICRISAT's main strategy in improving livelihoods, especially in the dry tropics of sub-Saharan Africa.

Let me conclude by congratulating all the team members of the APRLP-ICRISAT consortium who have done a commendable job. Water scarcity looms large over the world. Lessons we have learned from the APRLP-ICRISAT project can definitely help us win the Grey to Green revolution in the dry tropics.

I wish you all very fruitful deliberations.

Thank you, Namaskar.

Open and Distance Learning for Agriculture: A CGIAR Perspective*

Delivered during the Workshop on Open and Distance Learning for PG Education in Agriculture, 29 March 2004, India International Center, Lodi Road, New Delhi, India

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Colleagues in higher education, good morning.

On behalf of ICRISAT and the Consultative Group on International Agricultural Research (CGIAR), let me first express our total support to this novel initiative to establish a Global Open Agriculture and Food University (GO-AFU). In this era of funding uncertainty coupled with the strong need for national capacity building, innovative and cost-effective schemes like GO-AFU are very relevant.

Developing countries need to be supported in their efforts to develop their scientific and technological capacities, create modern institutions, and network for strategic alliances. National and international support must be provided in developing human resources necessary to harness these new institutional arrangements. Open and distance learning (ODL), enabled by Information and Communication Technology (ICT), is a solution to this.

Agricultural research for development has a record of delivering results. The science and technology that enabled the first Green Revolution was largely spurred by CGIAR and its national partners. This feat not only forestalled widespread hunger and famine in the developing world but also increased productivity and incomes of farmers and enabled the preservation of millions of hectares of forest and grasslands. Likewise, it conserved biodiversity and reduced carbon releases.

However, the existing wide yield gap between research stations and farms alerts us to the unrealized potential of science and technology. Given the enormity of this challenge, it is clear that

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* Presented by Dr Rex L Navarro, Head, Communication Office, on behalf of Director General William D Dar.

cutting-edge science must be applied to problems, especially of arid, semi-arid and tropical farming systems that were untouched by the first Green Revolution.

The CGIAR is currently undergoing major reforms designed to mobilize science, extend its alliances and optimize its impact. GO-AFU is one of such initiatives that ensure access to information, knowledge and cutting-edge technologies, especially for those who have not benefited from advances in science and technology. We believe that GO-AFU will be the catalyst of a second Green Revolution. The CGIAR, with its human and physical assets, has a tremendous opportunity to establish GO-AFU to effectively improve the skills of students and professionals from developing countries. The CGIAR has generated a large body of public goods over the last three decades, and has the manpower to develop solutions that increase agricultural productivity, reduce hunger and sustain the natural resource base. Moreover, the CGIAR System Review in 1999 underscored the need for the system to be a leader in harnessing the tremendous potential of ICT for knowledge sharing.

During the last three decades, open and distance learning has emerged as a significant sector in higher education. Visionaries have pointed out that ODL will make higher education a mass-based phenomenon in ways that were not conceived before.

A number of successful and sustainable projects harnessing ICT have shown that people can be empowered through timely information and knowledge. Likewise, a wide variety of training, communication and knowledge exchange functions in the CGIAR are beginning to take shape. For instance, our ICT-Knowledge Management (ICT-KM) Program is about to implement 15 projects to promote a seamless knowledge sharing scheme within and outside the CGIAR.

"Aided by ICT, GO-AFU will organize and deploy virtual expert groups cutting across the CGIAR and developing countries. This will certainly leapfrog our knowledge sharing efforts into the Information Age."

There are concerns that GO-AFU may duplicate programs and compete with national educational systems. However, I firmly believe that it will complement and add tremendous value to national ODL programs in agriculture and related fields.

The credo of the CGIAR's ICT-KM Program revolving around communication, collaboration and creativity faithfully describes GO-AFU's approach. First of all, GO-AFU will break communication barriers among CGIAR Centers, national systems and stakeholders to fully mobilize science and technology.

Secondly, GO-AFU will facilitate international collaboration to help improve the quality of instruction at regional and national universities, especially those in Asia and Africa. It will also work closely with CGIAR Centers, and the Canada-based Commonwealth of Learning (COL) to develop modules, establish a global repository of learning objects and deliver collaborative degree programs.

Thirdly, GO-AFU will develop creative mechanisms whereby our national partners and stakeholders can easily access our repository of learning objects and adapt these to their own needs. Through the creative interface of ICTs, GO-AFU will be able to share the right information with the right people at the right time anywhere in the world.

Aided by ICT, GO-AFU will organize and deploy virtual expert groups cutting across the CGIAR and developing countries. This will certainly leapfrog our knowledge sharing efforts into the Information Age.

At this juncture, let me mention that ICRISAT is leading an information, communication and non-formal distance learning coalition called VASAT, or the Virtual Academy for the Semi-Arid Tropics. VASAT is focused on sharing appropriate information and knowledge on drought management with farm communities and their intermediaries through the innovative interface of ICT and distance learning.

Before GO-AFU was conceived, we established VASAT together with our sister Centers like the International Water

Management Institute (IWMI), International Livestock Research Institute (ILRI), International Service for National Agricultural Research (ISNAR) and a number of NARS partners including the Indira Gandhi National Open University (IGNOU) in South Asia and the African Virtual University in West and Central Africa. I would also like to acknowledge COL's strong support to this initiative.

Let me emphasize that VASAT is an excellent complement to GO-AFU. While GO-AFU lays greater emphasis on postgraduate degree programs for professionals, VASAT focuses on non-degree and information-communication programs for farm communities and their intermediaries. VASAT and GO-AFU will collaborate in developing world-class modules on natural resource management, biotechnology and impact assessment.

We will also establish and share a virtual group of experts to put up a global repository of learning objects on drought, desertification and dryland agriculture with the assistance of COL.

During the last three decades, ICRISAT has been working closely with more than 100 universities in Asia and sub-Saharan Africa. Throughout these years, we worked together to train students, develop programs and strengthen national capacity in agricultural research. In spite of this, we feel that there is a need for further innovation in order to reach more stakeholders at a lesser cost. Hence, VASAT was born.

I foresee that GO-AFU will go beyond existing e-learning paradigms. I would like to see that GO-AFU programs are designed with national universities in the spirit of communication, collaboration and creativity.

We must therefore take advantage of this new development by working together. In this light, I congratulate IFPRI for the spadework done in conceptualizing GO-AFU. I also thank IGNOU for co-hosting this meeting together with ICRISAT and designating these institutions as nodal points for GO-AFU in Asia.

As leaders in knowledge generation and sharing, the CGIAR and its national partners should catalyze innovative knowledge sharing. And GO-AFU is one of the best mechanisms to make this happen.

The right time for us to act is now!

Thank you and good day.

Building a Strategic Alliance for Stronger Research Management

Keynote address during the 14th PHILARM National Convention, 14 April 2004, Carig Plaza Hotel, Santiago City, Isabela, Philippines

Fellow research leaders, good morning!

Allow me to thank PHILARM for inviting me to be with you today. As your fellow research leader, I am indeed honored to deliver this keynote address on your 14th national convention.

I fully support your timely theme "Strategic Alliance for Stronger Research Management Capability." In this era of seamless globalization and informatization, alliance building is indispensable. My organization, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), itself belongs to a strategic alliance, the Consultative Group on International Agricultural Research (CGIAR).

Created in 1971, the CGIAR is an alliance of public and private members supporting a system of 15 centers that work in more than 100 countries. We mobilize cutting-edge science to reduce

hunger and poverty, improve human nutrition and health and protect the environment. Advocating science-based approaches to solving some of the world's most basic problems lies at the heart of the CGIAR's mission.

The CGIAR has come a long way in improving global food security. In the fifties, sixties and early seventies, there was widespread belief that most developing countries would succumb to famine. These doomsday predictions were proven wrong by the impact of international agricultural research, together with supportive government policies and substantial efforts by farmers.

As a strategic alliance, the CGIAR has no constitution, statutes, regulations and membership laws. It reaches decisions by consensus, not by voting. Each part of the CGIAR system performs a distinct set of mutually supportive and complementary functions. These include strategic and medium-term planning, financing, resource allocation, monitoring and evaluation.

The CGIAR Chairman, a Vice President of the World Bank, provides the system with overall management and leadership. He helps harmonize policies and programs among various actors within the system. He also fosters linkages between the system and its partners. The CGIAR works with nearly all developing countries to strengthen their scientific capacities.

Since its inception, CGIAR scientists have received world-wide acclaim for their accomplishments.

"Team spirit makes an organization greater than the sum of its parts. It enables a vision to be realized."

Even more impressive has been the global sharing of the fruits of CGIAR's research. For over 30 years, the CGIAR has made a major contribution to poverty reduction and food security in developing countries. It has also achieved outstanding rates of return on investment.

At ICRISAT, we conduct research on sorghum, pearl millet, chickpea, pigeonpea and groundnut — crops that support the livelihoods of about 300 million people, the poorest of the poor. Our work encompasses the dry areas of 48 countries, mostly in sub-Saharan Africa and Asia. ICRISAT shares information and knowledge through capacity building, publications and ICTs.

Since the early seventies, ICRISAT has helped improve and sustain agricultural productivity in the most marginal environments. This accounts for about two-thirds of the world's cultivable land. Nevertheless, our difficult work has not gone unnoticed. ICRISAT has won the CGIAR's most prestigious King Baudouin Award three out of four submissions. This feat is unsurpassed by any other CGIAR Center.

The years before I joined were difficult times for ICRISAT. The period was marked by significant downsizing, staff unrest, financial challenges and unusual turnover in its Board and senior management.

Thus, improving the state of affairs in ICRISAT was my biggest challenge when I joined more than four years ago. Today, I am proud to announce that we have made a complete turnaround.

Last year, ICRISAT underwent two rigorous external reviews: one on research programs and another on research management. These reviews acknowledged this turnaround, revealed by the high quality of science at ICRISAT and its sound management.

Let me be specific by quoting pertinent parts from the external review report, especially those related to management.

1. "A period of stability has begun, with improved organizational structures, and with strengthened financial, human resource, information and support systems in place."

2. "Under constrained circumstances, the Center has been able to adjust and improve its operations. The management has done well to reduce and focus the Center's human resources, rebuild staff confidence, and implement human resource management systems."

3. "Overall the leadership and culture have changed significantly for the better during the past two years as a result of leadership initiatives..."

4. "The Director General has successfully focused effort and attention on building a unified ICRISAT where staff work together collaboratively to ensure a common vision and enhance ICRISAT's international standing."

5. "This focus has not only brought scientists, management and support staff together but created a shared mission and belief that despite fiscal cutbacks there can be stability and a sense of optimism for the future."

6. "The Director General has been effective in creating a team that wants to support each other and to excel. The Panel believes there is a strengthened sense of optimism throughout the Center."

7. "Team building work that has brought scientists and managers together has contributed to the opening of a more honest dialogue in the Center."

8. "The Board and the current management are to be commended for creating a more stable environment in the Center."

We are about to release a book that chronicles the results of the two external reviews. Be assured that PHILARM will receive a copy of this book. You may be wondering what formula we used to turn ICRISAT around and lead it to excellence. Let me share what I call "Formula Ten" for effective leadership and management.

1. *Chart a vision and develop a game plan*

A leader must be able to provide a clear vision of a transformed future. Vision encompasses strategy and goal setting. It is more

than simply having a plan. Vision is a passionate commitment to creatively bridge the gap between the present and the desired future. When I joined ICRISAT, I advocated *Science with a human face*. This is our overarching battle cry in pursuing our vision – the improved well-being of the poor of the dry tropics.

2. *Communicate your vision*

A vision is meaningless unless it is shared with others. A leader must possess a wide range of communication skills. This includes articulating issues, listening to others and synthesizing diverse perspectives of constituents. In all my speeches and presentations, I consistently articulate *Science with a human face*. If you come to ICRISAT, you will notice that this is conspicuously posted on our campus, in all our publications and even on our buses.

3. *Hire excellent people and delegate authority and responsibility*

Outstanding people make outstanding organizations. Human resources are most essential in building great institutions. Consequently, outstanding people give confidence to a leader in delegating authority and responsibility. I delegate authority and responsibility to my Regional Representatives in sub-Saharan Africa. We also give wide latitude of decision-making to our Global Theme Leaders and scientists. I am proud to lead an organization with excellent people. This is manifest by the more than 40 awards that ICRISAT has received during the last four years.

4. *Build a strong team*

Leaders develop dynamic networks, relationships and a culture that builds a strong team in the organization. Building a strong team enables a leader to mobilize followers who are eager to cooperate for the greater good. Team spirit makes an organization greater than the sum of its parts. It enables a vision to be realized. Team ICRISAT made us overcome the divisiveness that had plagued the Institute for decades.

5. *Make sound decisions and take risks*

True leaders have the courage to act. They take risks and make tough decisions. Without taking risks, leaders cannot move

their organizations forward. Thus, leaders must be willing to make bold moves and embrace the seemingly impossible. In order to stabilize ICRISAT then, I personally took risks in disposing elements inimical to the interests of the Institute.

6. *Admit mistakes and apologize when needed*

A leader who is a risk taker allows room for mistakes. Hence, a leader should quickly recognize mistakes, apologize and rectify the situation. Outstanding leaders learn from their mistakes and make amends. I don't hesitate to say "I'm sorry" if I know I have made a mistake.

7. *Be trustworthy and care about others*

Visions are based on core values. For good leaders, the means are just as important as the end. They pursue reforms with integrity, taking right actions for the right reasons. They know that trust and credibility are central to leadership. I trust and care for my people as I care for the cause of ICRISAT.

8. *Be humble yet firm*

In our culture, humility, especially among leaders, is a highly regarded virtue. In a broader sense, humility enables leaders to have a modest estimate of their own worth. It also enables them to submit themselves to others without being weak. Humility consists of keeping oneself within one's own bounds, not claiming things one does not have. I am a humble son of the soil, but I am also firm as a leader.

9. *Never give up*

Never give up. Work hard. These are at the heart of successful leadership. The best leaders love what they do and put their hearts into it. Leaders make commitments and are determined to see them through. When almost everybody had lost hope, I persisted in pursuing what later turned out to be our biggest funded initiative — the Desert Margins Program.

10. *Have a sense of humor*

Good leaders laugh with others and at themselves. They maintain a healthy sense of balance and perspective. They know that humor often diffuses a tense situation. I usually laugh with my colleagues, especially to unfreeze a tense situation.

It is said that "managers are people who do things right, and leaders are people who do the right thing." I would say that we must do the right things the right way. At this juncture, let me congratulate PHILARM through its outgoing President, Dr Teotimo M Aganon and its incoming President, Dr William C Medrano. I fully subscribe to PHILARM's vision as a leading professional organization for R&D management in the Asia-Pacific region.

PHILARM faces a big challenge in helping turn around the Philippine economy. In spite of the growth of the industrial sector, agriculture is still the driving force of the national economy. But by global standards, Philippine agriculture has been lagging behind in the past two decades.

It is therefore imperative that we work together to accelerate the growth of Philippine agriculture. The wealth of information and knowledge generated by international agricultural research must be mobilized to make this happen. PHILARM must therefore build a strategic alliance with the CGIAR, LGUs, the private sector, civil society organizations and most of all, farmers.

Before I close, let me reiterate CGIAR's commitment in general and that of ICRISAT in particular in helping modernize Philippine agriculture. Dr CLL Gowda will report the latest developments in our collaborative program in the Cereals and Legumes Asia Network (CLAN).

By building a strategic alliance, we can bring about a second Green Revolution in this country. But this time, we must do it.

Maraming salamat at mabuhay kayong lahat!

Nurturing the Youth for a Responsible and Conscientious Citizenry

Speech delivered during the Annual Commencement Exercises of the Central Luzon State University, 16 April 2004, Muñoz, Nueva Ecija, Philippines

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My beloved colleagues and graduates, good afternoon!

I thank President Undan and all of you for inviting me to be the Guest of Honor and Speaker in today's commencement exercises. I am indeed honored to speak before the graduates of CLSU – the lead agency of the Muñoz Science Community and seat of the Regional Research and Development Center of Central Luzon.

I am happy to note that CLSU is now one of the premiere institutions for agriculture in the Philippines and in Southeast Asia. Your institution is widely acclaimed for its research breakthroughs in aquaculture, ruminants, crops, orchard and water management.

CLSU's vision as a model comprehensive institution of higher learning dedicated to service and excellence is very appropriate. Likewise, its mission of developing superior human resources and technologies for people empowerment, global competitiveness and sustainable development is very timely.

I intend to focus my speech on the graduates, hence I titled it as "Nurturing the youth for a responsible and conscientious citizenry." Our country and the whole world face gigantic challenges today. Poverty, hunger, conflict, terrorism and crime abound amidst globalization, informatization and the gene revolution.

The 21st century that you will inherit is truly fast changing, a global village, a world of meritocracy, free economy, pluralism, a society of diversified cultures, traditions and civilizations. Relentless forces such as huge capital flows and advances in information and communication technology are creating tremendous opportunities.

Within this global context, modern civilization is now at a crossroads. The United Nations urges us to choose pathways that will determine the collective future of humankind. For example:

1. Innovation or stability: should we depend on science and technology to solve problems, or control its use?
2. Resource quantity or quality: should we put higher living standards first, or prefer less with better equity?
3. Group honor or its endurance: should we use violence to survive ethnically, or avoid conflicts for universal peace?
4. Human relations or individuality: should we give priority to collective or personal rights?

"Therefore, as a patriotic Filipino, it is not enough that you simply graduate to obtain a prestigious degree. You must become a missionary for our people."

5. Identity or governance: should we give priority to unique cultures, or promote global institutions?
6. Prerogatives or obligations: should we maximize group and private liberty, or stress social responsibility?
7. Hard facts or moral judgment: should we seek the truth, however unwelcome, or promote standards no matter how costly?

Today, as graduates, you are also at the crossroads. The end of your university education heralds a new, yet more challenging phase of your lives as responsible and conscientious citizens. In this new phase, I challenge you to become missionaries. My definition of the word missionary is "a person sent on a mission."

As responsible and conscientious citizens, you must fulfill a mission in your lives. Indeed, you accepted a mission when you enrolled in a publicly funded educational institution like CLSU. Your education has been subsidized by taxes from our people. Therefore, as a patriotic Filipino, it is not enough that you simply graduate to obtain a prestigious degree. You must become a missionary for our people.

Your mission, in the light of the challenges I mentioned earlier, is to do something for our people. With you as the new missionaries, we can vigorously move forward to help realize the country's development goals. But you may ask, how do you succeed as a missionary?

Allow me to share my own professional experiences. Like you, I also sat and listened to a commencement address in Benguet, not so many years ago! I patiently listened to the speaker, wondering what was in store for me.

But deep inside, I knew I had a mission to help the poor, and I was determined to succeed. I then set my sights on a career in the public service. I worked very hard, starting as a government farm management technician. Inspired by my mission, I eventually worked my way to the top, not only in the service of Benguet, my home province of Ilocos Sur, the academe, the whole country and also now, serving 48 developing countries of the world.

Before I knew it, I became Vice President for Research and Development at the Benguet State University. I then moved to the Department of Agriculture as the first Director of the Bureau of Agricultural Research (BAR). From here, I became the fifth Executive Director of the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD). Later on, I became the Secretary of Agriculture and then Presidential Adviser on Food Security and Rural Development.

During this time, I met and interacted with eminent scientists, development leaders and policymakers from all over the world. Meeting people from other cultures is very enlightening; far more than what you get from reading.

Opportunities of travel abroad increased. Through these travels, I was exposed to the problems of poor people in places far less fortunate than our country.

These experiences developed in me a deeper commitment and they further strengthened my resolve to pursue my mission.

I realized that I could do something to help solve the global problems of poverty, hunger, malnutrition, environmental degradation, and now, social conflict – problems that beset our country today.

In time, I came to serve ICRISAT, the International Crops Research Institute for the Semi-Arid Tropics, as its fifth Director General. I am humbled to be the first Filipino and Asian ever to be appointed to this prestigious position.

ICRISAT serves 48 countries of the dry tropics of the world, home to about 800 million people who are the poorest of the poor. Our core business is to improve agriculture in the dry tropics, spearheading a Grey to Green Revolution which is guided by *Science with a human face*.

A Grey to Green Revolution makes us turn adversities into opportunities for the poor.

Science with a human face means that we harness science as a means to serve the poor, not an end in itself.

Throughout my life, it has been my missionary zeal which drove me onward to where I stand today. I could not have done this alone. I owe all of these to my parents, relatives, mentors, colleagues and my family.

At this juncture, let me mention one of my most influential mentors — Dr Fortunato Battad, your President Emeritus. He was responsible for molding me into a leader and a faithful citizen of our country.

The most fulfilling mission is to serve the poor. The big question then is, how do you begin your mission? Chris Anderson, in his article "The Young", explores the growing influence of youth in the new information and economic order. He says that the youth are in a good position to change the world, thanks to the shift in power, responsibility and technology once reserved for your elders.

The rapid and relentless pace of technological change favors you, since you learn and relearn new tools faster and can afford to take risks associated with them. In organizations, old hierarchies are giving way to meritocracies in order to compete and adjust to change.

It is said that the highest form of courage is the courage to change. You welcome change, think flexibly and technologically, risk your future and prefer opportunity to wealth. In other words, young people are not only the leaders of tomorrow. Increasingly, you are the leaders of today. Apart from being leaders, do not forget that you should also be responsible citizens and stakeholders of our country. Being the youth, you will secure our country's present and future. Doing this will require determination, commitment, energy and fresh insights.

Mother Teresa, who as you know lived and worked for the poor in India where I now work, was a great inspiring soul. Her life is an example of how a person, even small in stature, can achieve great things for the poor. She once said something that I cannot forget: "You don't need to do great things. Just do little things in a great way."

Thus, no matter how humble your chosen mission is, as long as it contributes to helping the poor, you are on the right track as a

missionary. The father of India, the late Mahatma Gandhi, once said: "A small body of determined spirits, fired by an unquenchable faith in their mission, can alter the course of history."

Likewise, Thomas Jefferson said, "I know of no safe depository of the ultimate powers of society but the citizens themselves, and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them but to inform their discretion."

Let me end by quoting a great thinker who said, "Everybody can be great... because anybody can serve. You don't have to have a college degree to serve. You don't have to make your subject and verb agree to serve. You only need a heart full of grace. A soul generated by love."

With these words, I wish you well, Godspeed and good luck on your new mission in the service of the poor. With God's help, I am confident that all of you will succeed.

Mabuhay kayo at magandang hapon sa inyong lahat!

Reaching Asia's Rural Poor: ICT in Agricultural Extension and Communication

Address during the South Asian Regional Workshop on Good Practices in ICT4D and their Relevance to Agricultural Extension and Communication organized by ICRISAT in association with the COL and the CGIAR ICT-KM Program, 28-29 June 2004, ICRISAT Patancheru, Andhra Pradesh, India

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Dr Nachiket Mor, Professor Ken Keniston, Professor Panjab Singh, Professor Krishna Alluri, colleagues from ILRI and IWMI, distinguished invitees and my esteemed colleagues. Let me start by extending my warmest welcome to all of you at ICRISAT.

We are indeed honored by the presence of eminent educators and personalities in our regional workshop on good practices in Information and Communication Technology (ICT) and their relevance to agricultural extension and communication. Many of you here have made significant contributions to technological innovations in ICT. Likewise, some of you have brought governance closer to ordinary people using ICT.

We also have with us new-generation bankers who are promoting sizeable enterprises in their attempts to bring ICT to the rural areas. Today, a new paradigm of agricultural development is fast emerging. Throughout the world, the development of rural areas is expanding in new directions. Thus, conventional ways of delivering important services to rural people are being challenged.

Apart from biotechnology, the ongoing revolution in ICT offers tremendous potential in helping tackle poverty, food insecurity and malnutrition in the developing world.

With ICT, traditional societies are being transformed into knowledge societies all over the world. When used as a tool for providing local farm communities with scientific knowledge, ICT heralds the emergence of knowledge societies in rural Asia and the whole developing world. ICT builds communities of people communicating and learning together even across great distances.

Knowledge and information are essential for poor people to respond successfully to social, economic and technological opportunities. In fact, the Asian Development Bank (ADB) foresees that countries that will bridge the digital divide by harnessing the potential of ICT can look forward to enhanced economic growth and improved human welfare and governance.

ICT has indeed become a powerful tool in fighting poverty, providing developing countries with an unprecedented opportunity to meet vital development goals. Moreover, ICT can expand information flows and make knowledge more accessible, facilitating poor people to make better choices, articulate their opinions, demand their rights and have more control over their own destiny.

"When used as a tool for providing local farm communities with scientific knowledge, ICT heralds the emergence of knowledge societies in rural Asia and the whole developing world."

On a broader level, ICT can help break down isolation and structures of discrimination, and support new forms of economic and social innovations that benefit the poor. Experience has shown that conventional methods of information-knowledge sharing are no longer adequate, especially for wider agricultural research and extension impact. The contemporary situation demands more innovative and efficient access to appropriate information-knowledge by the poor.

As improved technologies and practices are developed by research, and new rural enterprises spread, the need for continuous access to information-knowledge and support services by farm families, local organizations and communities increases.

We at ICRISAT view ICT as the vital link that connects policymakers, researchers, extensionists, support providers and farm communities. Nevertheless, this can only be realized when relevant content is effectively harnessed for agriculture and rural development.

In this rapidly changing world, agricultural extension and communication is an essential mechanism in sharing knowledge for farmer empowerment.

ICT promises many potential applications in agricultural extension and communication. It can bring new information services to rural areas where farmers will have greater control over current information channels. Access to such new information sources is crucial for the sustainable development of Asia's farming systems.

However, national agricultural extension systems are severely constrained by low capacity, poor implementation of decentralized services, a top-down mode of delivery and weak linkages with research and farmers. Moreover, agricultural extension has yet to go beyond the traditional mindset of 'technology transfer.'

Through ICT, agricultural extension is becoming more knowledge intensive, demand driven and diversified in content.

In this mode, agricultural extension is more effective in meeting farmers' information needs.

The strides made in the ICT sector in Asia are indeed striking. Countries such as Taiwan and Singapore are established leaders in designing and manufacturing hardware, while India is acquiring the reputation of a software superpower. An extraordinary amount of wealth is being created in Asian societies because of ICT's growth and deployment.

The ICT4D movement presents the human face of technology-inspired economic growth. ICT4D fits in within the vision of ICRISAT which pursues research for impact. We place a premium on achieving scientific excellence and keep in focus the human face of the primary producer, the farmer.

In his first major policy speech, the new Prime Minister of India deplored the neglect of Indian farmers in recent years, leading to a slowing down of agricultural growth. He cited farmers in many parts of the country who have faced distress with no helping hand.

Right here in Andhra Pradesh, more than 400 farmers have taken their own lives in the past month due to unpaid debts.

The Prime Minister also emphasized that agricultural research, training and extension should be given greater attention. In this light, ICT4D can certainly help fulfill the new government's "New Deal" for rural India.

If the talents and expertise present in this gathering are combined, I believe the challenge for a "New Deal" for rural India and the whole of Asia can be solved within a reasonable time.

Therefore, in this workshop, I would like to pose two questions:

1. How do we ensure food and livelihood security among Asian farmers and rural families using ICT?

2. How do we empower food-insecure and vulnerable rural families with the vast knowledge that agricultural research has generated?

This workshop is meant to initiate a synergy among three different groups of actors: ICT4D pioneers, experts in agricultural research and leaders in open distance learning.

We envision a triple helix model of a knowledge system for food security that has these actors as the strands. We in ICRISAT have always been optimistic, and we believe that ICT does have a role in enabling sustainable food security for all. This is a belief we share with our colleagues in the CGIAR System.

In this context, ICRISAT is leading a project called the Virtual Academy for the Semi-Arid Tropics (VASAT). VASAT is a coalition of local, national and international organizations.

VASAT is an effort to enable frontier science and technology to meet the needs of food-insecure and vulnerable rural families. We need to share information and knowledge to empower those families in facing the challenges of drought, global markets, underemployment and undernourishment.

The VASAT concept has already found counterparts: the Open Academy for Philippine Agriculture that was recently launched through our assistance and the MS Swaminathan Research Foundation-led Open Academy for Food Security and Rural Development in India. The CGIAR, our umbrella body, will also launch a Global Agricultural and Food Open University, which is another partner of VASAT.

We acknowledge the vital support extended by the Commonwealth of Learning (COL) in our efforts to launch

VASAT and in organizing this workshop. Likewise, the ICT-Knowledge Management program of the CGIAR has offered to extend support.

At this juncture, I would like to emphasize that ICT is the best complement and supplement to agricultural extension and communication. However, it cannot replace it. The human face of the extensionist or the change agent is non-replaceable, since most rural areas are still poor and farmers have yet to be brought into the loop.

ICT is a powerful tool that helps researchers and extensionists share the right information and knowledge with the right people at the right time.

I am confident that our deliberations in this workshop under the coordinatorship of Dr V Balaji will be meaningful in giving a "New Deal" to Asia's rural poor. I also hope that you will see the range of information and knowledge that ICRISAT has generated in winning the Grey to Green Revolution.

Thank you and good day!

Agricultural Technologies for Rural Development

Inaugural address at the International Training Program on Agricultural Technologies for Rural Development, National Institute of Rural Development (NIRD), 2 August 2004, Hyderabad, India

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Overview

Ladies and gentlemen, good morning.

It is a pleasure delivering the inaugural address for this important training on technologies for development and integrating them with rural development.

A vast majority of the population in developing countries lives in rural areas with agriculture as the major source of their livelihood. However, agricultural production in these countries is largely done in the dry tropics. The dry tropics are very fragile and inherently suffer from low soil fertility. They also have low and erratic rainfall and poor physico-social infrastructure.

Issues such as growing global warming, increasing water shortages and a burgeoning population will not improve the situation unless addressed urgently. Dealing with these challenges requires a globally coordinated and multi-institutional effort.

International Agricultural Research Centers (IARCs) like the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) were established to help address these issues. ICRISAT, like other centers under the umbrella of the Consultative Group on International Agricultural Research (CGIAR), envisioned the need for partnership-based research in developing and sharing agricultural technologies. In recent years, this partnership has grown in magnitude and diversity to synergize the complementation of a diverse range of institutions around the world.

ICRISAT performs agricultural research with increasing emphasis on interdisciplinary integration through its global themes. We focus on research-for-development in various areas of dryland agriculture in partnership with national programs.

However, technology generation is just one step in the chain of activities needed to improve the livelihoods of rural farming communities. Developing these technologies into profitable commercial ventures and empowering intermediaries and farming communities by their utilization is also important. Our approach at ICRISAT has made a significant contribution to meeting rural development goals, primarily in the dry tropics of Asia and sub-Saharan Africa. Let me cite a few examples.

Crop improvement

ICRISAT has a mandate to undertake genetic improvement of five dryland crops. These include two cereals (sorghum and pearl millet) and three legumes (chickpea, pigeonpea and groundnut). More than 541 improved varieties of these crops developed by ICRISAT in partnership with national agricultural research systems (NARS) have been released in 72 countries since 1975.

Many of these varieties have attained varying levels of farmers' adoption. Sorghum and pearl millet hybrids have shown 20-30% grain yield advantage over other varieties. The biggest breakthroughs from these two crops have occurred through hybrid technology in India in partnership with NARS and the private sector. About half the total area under sorghum and pearl millet in India are planted with more than 70 hybrids.

ICRISAT is also a leader in pigeonpea hybrid technology. Pigeonpea hybrids are showing 20-30% grain yield advantage

"Our approach at ICRISAT has made a significant contribution to meeting rural development goals, primarily in the dry tropics of Asia and sub-Saharan Africa."

over other varieties. Hence, we expect that impacts achieved in sorghum and pearl millet will be repeated for pigeonpea in the near future.

The development of a short-duration and Fusarium wilt-resistant kabuli chickpea variety ICCV 2 is another success story in varietal development. This triggered rapid chickpea adoption and area expansion in Andhra Pradesh initially.

ICCV 2 along with another kabuli variety KAK2 and three desi varieties are now widely grown in this State. It has resulted in about a 5-fold increase in area planted and a 13-fold increase in production.

These successes are the result of conventional breeding approaches. Modern biotechnology holds the promise of enhancing the pace, efficiency and precision of plant breeding. Biotechnology research at ICRISAT has succeeded in developing the world's first transgenic groundnut cultivar that has resistance to peanut clump virus and now under controlled field trial. This disease causes annual yield losses of US$38 million globally.

Likewise, biotechnology has also succeeded in developing transgenic pigeonpea with resistance to pod borer. This is the most devastating insect pest of this crop and other legumes including chickpea. Integrating this technology with conventional hybrid breeding will surely bring about a breakthrough in pigeonpea production, now looming on the horizon.

Transgenic research at ICRISAT is working on several other areas such as developing drought-tolerant chickpeas. We are also planning to develop a program using groundnut and chickpea as delivery vehicles for edible vaccines against diarrhoea, hepatitis and rabies.

Integrated disease and pest management

The level of genetic resistance and its availability in germplasm has been adequate to manage some major plant diseases. However, these breakthroughs have only been partially achieved for other diseases. Research on alternative control

measures, including their integration with host plant resistance, has been successful at ICRISAT. This has led to several effective technologies and their application.

Helicoverpa pod borer is the most devastating insect pest of grain legumes, causing annual global losses of over US$600 million. Through ICRISAT's research, remarkable successes have been achieved in pursuing alternative technological options. For instance, transgenic research has now introduced Bt and SBTI (soybean trypsin inhibitor) genes into pigeonpea cultivars that show high levels of pod borer resistance.

Similarly, strains of a fungus (*Metarrhizium* sp.) and a bacteria (*Bacillus* sp.) found highly pathogenic to the pod borer have been identified. Cost-effective and simple production protocols for these microbial inoculants have also been developed.

When used in Integrated Pest Management (IPM) packages, these bio-control measures provide greater control over pod borer damage. These are also eco-friendly approaches since they make pod borer control sustainable by encouraging the build-up of natural enemies of this pest and reduce chemical pollution of the environment.

Among the ICRISAT mandate crops, groundnut is particularly vunerable to aflatoxin contamination. ICRISAT played a key role in developing a simple and cheap ELISA kit that is now used by a poultry feed manufacturer in Hyderabad, and for germplasm screening at ICRISAT.

We have also developed high-yielding groundnut varieties with moderate levels of resistance to aflatoxin contamination. IPM technologies consisting of resistant varieties, application of farmyard manure, gypsum and Trichoderma along with drought management practices have been found effective in reducing pre-harvest aflatoxin contamination in groundnut.

ICRISAT has been quite responsive in developing partnerships to address crisis situations related to crop management. For instance, a groundnut disease in 2000 in Anantapur district of Andhra Pradesh destroyed the crop completely. This caused an estimated yield loss of US$65 million. ICRISAT in

partnership with the National Bureau of Plant Genetic Resources (NBPGR) and the Acharya NG Ranga Agricultural University (ANGRAU) dealt with this challenge. We developed an effective technology by:

- Using disease-free seed produced in the area
- Planting quick growing cereals such as sorghum and pearl millet as intercrops and on borders
- Cultivating groundnuts in fields away from other fields growing sunflower and/or marigold, and in which alternate host weeds such as parthenium had been removed.

Natural resource management

Protection and improvement of the natural resource base hold the key to increasing not only crop productivity, but also its profitability and sustainability. Thus, natural resource management technologies must take a holistic view of production system management that integrates improved crop cultivars with soil-water-nutrient management, biodiversity enhancement and other employment-generating activities.

A consortium approach to farmer participatory integrated watershed management developed and implemented by ICRISAT has been a great success story in this regard. This research and development work initiated with our national partners increased the productivity and cropping intensity of rainfed crops, doubled farmers' incomes, increased groundwater availability and increased green cover in just five years.

This model has been scaled up in 50 villages in three districts, and is being further scaled up in 100 villages in five districts of Andhra Pradesh. The integrated watershed management concept has been extended to and adopted by farmers in other parts of India and in other Asian countries such as Thailand, Vietnam and China.

Information and knowledge sharing

New agricultural technologies can contribute to rural development only when they are translated into profitable business ventures for the areas they are needed most, and are

transferred at the right time in the right way. ICRISAT pioneered a new approach, encapsulated in the Technology Innovation Center (TIC).

The TIC aims to accelerate agriculture-based technology sharing and commercialization by fostering the development and innovation of agri-business enterprises. The TIC operates with the Agri-Biotech Center and Agri-Business Incubator as its major ventures. Parallel to TIC, ICRISAT pioneered the establishment of what is known as the Virtual Academy for the Semi-Arid Tropics (VASAT).

The objective of VASAT is to mobilize communities and intermediaries of the dry tropics by sharing information, knowledge and skills related to climate literacy, drought preparedness and best practices in dryland agriculture.

VASAT is a strategic and community-based alliance that will harness the potential of existing community networks to deliver generic and demand-driven content. A pilot ICT4D site under the Andhra Pradesh Rural Livelihoods Project in Addakal region of Mahbubnagar district, one of the most drought-prone areas of India, is run by a federation of all-women micro-credit groups.

A spectrum of locally relevant information services is offered by trained workers on site, covering local input prices, market prices and weather and wage information. This site also serves as a window for ICRISAT and its partners to obtain a picture of current and future information needs across different segments of the rural population.

Conclusion

Despite our successes, many challenges remain in the dry tropics. Finding ways to improve the conditions of the world's poorest people is surely one of the most daunting challenges facing us. The immense problem of soil degradation due to drought and human activity across much of Asia and sub-Saharan Africa revolves around a central dilemma — how can the poor achieve sustainable livelihoods in areas where the natural resource base is so fragile?

Our efforts to answer this basic question guide our new
and strategy. Limited water is of course the central const
the dry tropics. Yet, opportunities exist for us to use
much more efficiently. Turning adversities into opportun
at the heart of a movement we call the Grey to
Revolution, guided by *Science with a human face*. W
demonstrated that the Grey to Green Revolution can be
to the attainment of our vision for agriculture, especially
dry areas of India.

Before I close, let me once again thank our scientis
partners for the good work they are doing to improve th
of our poor farmers. Through their collaborative effor
millions of poor who live in the dry tropics of India and th
are being empowered to extricate themselves out of p
through the Grey to Green Revolution.

This will certainly help bring about a 'New Deal' for rural I

Thank you and good day.

The Virtual Academy for the Semi-Arid Tropics (VASAT): Harnessing the Power of Partnerships and Contemporary Information Technology to Enhance Food and Livelihood Security in the SAT

Dr BP Pal Memorial Lecture, 5 August 2004, Indian Agricultural Research Institute, New Delhi, India

I consider it a rare privilege to have been invited to deliver the Dr BP Pal Memorial Lecture this year. The late Dr Benjamin Peary Pal was a renowned wheat breeder who fostered the setting up of one of the best wheat improvement programs in the world. He was a great institution builder, and encouraged a number of bright young scientists to take up highly ambitious research projects whose results contributed much to building a food-secure India. His legacy as the founder-director general of the Indian Council of Agricultural Research (ICAR) lives on to this day in the continuing quest for new paradigms for harnessing frontier science and technology to enhance food security of the poor.

Drought and desertification are emerging as serious problems in sub-Saharan Africa as well as in South Asia and have the potential to undermine the food security of large masses of people. Hon. Kofi Annan, the Secretary General of the UN, recently observed that they threaten the lives of hundreds of millions of the world's poor in 130 countries. A very large part

of the drought-prone areas of the world are located in the tropics. This region, the semi-arid tropics (SAT) is also home to some of the poorest in the world. How can recent advances in science and technology be harnessed so that the poor of the world can overcome the problems of drought and desertification? Recent trends in organizational management reveal that partnerships based on sharing, rather than a corporate power entity, can effectively handle issues of resource scarcity. Can we draw a lesson from this to develop more effective drought and desertification mitigation strategies?

In this talk, I shall outline one of the many measures that ICRISAT has initiated and designed to blend the best in frontier science and technology and leveraged to the advantage of the poor using partnership power. I refer here to the Virtual Academy for the Semi-Arid Tropics (VASAT) project, which is our attempt to take advantage of new information and communication technologies, and to harness the power of direct as well as virtual partnerships to create and disseminate new international information public goods.

ICRISAT was founded in 1972 on the foresight and vision of a number of science leaders and organizations that played a key role in bringing about the Green Revolution in Asia. It is an eco-regional institution with the formidable mandate of enhancing food security in the drought-prone tropical regions of sub-Saharan Africa and Asia, where some of the world's poorest families live. Since its inception, the science leaders in ICRISAT have devoted attention to both these regions to develop relevant as well as durable research programs and in building and strengthening capacity among the scientists and technical workers of the SAT region in the developing world.

ICRISAT's scientific excellence in SAT agriculture is well established: Team ICRISAT won the prestigious King Baudouin

"Recent trends in organizational management reveal that partnerships based on sharing, rather than a corporate power entity, can effectively handle issues of resource scarcity."

Award of the CGIAR on three out of four occasions. ICRISAT has also trained close to 10,000 public sector NARES scientists and technicians from 99 countries in the last 28 years, and maintains close working relations with 130 universities and advanced research institutes in the world. Most of these training activities took place in ICRISAT's India-based facilities, thus making it a unique platform for South-South cooperation. With such extensive partnerships and networks, ICRISAT has an extremely successful varietal improvement and release program that has generated significant impact on food security in our host country, India, and in many countries in sub-Saharan Africa.

Of late, ICRISAT has also begun working closely with new and important actors emerging in the post-globalization scenario in the SAT. The private sector and the not-for-profit NGO sector have emerged as significant players in the research-for-impact paradigm. ICRISAT has a comprehensive program to promote public-private partnerships to add value to the extraordinary public investment it has made in advanced scientific research. ICRISAT hosts the consortium of private seed producers in India, the Agri-Biotech Incubator with the Government of India, and is actively developing an Agri-Science Park (ASP).

More importantly, ICRISAT has launched the Farmers Days program in both the regions of the SAT where it is active. In the last three years, over 10,000 farmers and their families have participated in this program, which is designed to bring them in direct contact with practitioners of the best in science. This has given a fillip to our science leaders to make participatory methods an inherent feature of our work. Successful projects in watershed development are based on an intensive use of a variety of participatory tools and methods, and the generic methods are continuously improved and adapted to suit different countries. This has also led to the introduction of altogether new components in our work, such as the African Market Gardens in West and Central Africa and carbon-sequestration projects in rural India.

The situation in the SAT today is a challenging one in the way new resource scarcities are emerging. It requires researchers to

be even more proactive in reaching out to large masses of vulnerable people and to their own organizations. Novel communication strategies are needed to make drought preparedness a truly mass phenomenon. The power of radio communication in bringing about the success of the Green Revolution in Asia is widely accepted. In today's context, multiple mass media technologies and channels exist with extraordinary outreach capabilities. Harnessing them to create new advantages for poor and vulnerable families calls for bold and innovative measures. Internationally, development communication experts are of the view that any novel approach in this effort must integrate the top-down as well as the bottom-up approaches. The vulnerable families should be able to communicate their coping strategies and concerns to experts, and a two-way, interactive process of communication is essential in building this new approach. Contemporary information and communication technology (ICT) with its host of digital networking technologies, offers unprecedented opportunities. Let me describe how the VASAT project is making use of these opportunities.

ICT applied to development, or ICT4D as it is known in the international development sector, is becoming a movement in itself. South Asia is considered to be the international test bed for ICT4D, with almost 150 projects in progress. The actors are highly diverse, ranging from rural NGOs to large corporations, and the projects are of varying scales and sophistication. A number of national organizations such as the MS Swaminathan Foundation in India, or the Grameen group in Bangladesh are well known for their pioneering work in this area, and there are important ICT4D regional networks such as Chasquinet in Latin America or Acacia in SSA that are considerably influential even in policy matters. Their success was a factor that encouraged the UN system to convene the World Summit on Information Society (WSIS) earlier this year.

Critical studies on the impact and sustainability of such projects reveal that the long-term sustainability of rural ICT4D projects is dependent upon their information function and not just on the innovative connectivity technology adopted. Delivering an information service that is locally relevant and meets local

demand is expected to lead to a model for local revenue generation and sharing that will assure sustainability. Among the many rural ICT4D models, the one that promotes value-addition to generic information is more sustainable. Such a model helps in converting information in the networks (usually in international languages) into information and knowledge that can be locally acted upon. These conclusions were confirmed at a South Asian regional workshop on Good practices in ICT4D that we in ICRISAT had organized earlier this year.

The Open and Distance Learning (ODL) paradigm today has evolved into a system for mass education beyond the formal school. It has a presence in every developing country. There is a felt need in many developing countries for opportunities for life-long learning. The ODL system has emerged as the most suitable means to achieve this goal, and ODL leaders such as the Commonwealth of Learning (COL) accept such developmental objectives as imperative. When combined with emerging ICT4D practices of using contemporary ICT to deliver information in rural areas, the ODL paradigm can offer new models for information and knowledge-oriented outreach in rural parts in the developing world.

VASAT is founded on the practicability of blending these two approaches with the agricultural research-for-impact paradigm in which we are all involved.

ICRISAT has established a pilot ICT4D site in collaboration with the Andhra Pradesh Rural Livelihoods Project in Addakal region of Mahbubnagar district, one of the most drought-prone areas of India. This is run by a federation of all-women micro-credit groups comprising of a substantial number of poor families in the area. Initial work in this site included the setting up of basic connectivity and comput-

ing infrastructure and imparting extensive training to federation nominees (all women) in contemporary information management methods. A variety of locally relevant information services is offered by the trained workers on site, covering local input prices, market prices, the weather and wage information. This site also serves as a window for ICRISAT and its partners to obtain a picture of current and information needs across different segments of the rural population (approximately 45,000 individuals). The quality of information services offered by the federation is today recognized by the district administration, which has granted them the status of a rural e-seva or e-governance center, one of the first such rural centers in the State of Andhra Pradesh. The site also serves as a test bed for evaluating a number of agricultural and livestock information products. ICRISAT is also setting up a site in Kahe near Sadoré in Niger in West Africa. The principal technology in Kahe is the community radio linked to a satellite-based digital radio system operated by World Space Corporation. A local NGO is the lead partner in Kahe.

VASAT is a partnership-oriented effort and functions wholly in a consortium mode. The number of partners is growing and a list can be found on the VASAT website (http://www.vasat.org). In India, the principal partners include ICAR and IGNOU. A series of consultations with partners held in India and Niger over the last one year led to the emergence of the following points for action:

- VASAT actors should focus on primary users, namely rural families, their own organizations and credible intermediaries
- The material generated should be highly customizable to suit local requirements in a short span of time
- An element of non-formal instruction should be built into an information service; content should be in a granular, easy-to-absorb form rather than in a heavily packaged format.

These are now fully ingrained in VASAT's work. The VASAT partnership is organized into three levels: at the first level are those that own and operate ICT-based rural information centers that are linked directly to rural families; at the second level are those partners who are in a position to adapt or re-

create locally relevant content and who are linked to the rural information hubs; and at the next level are those who are able to generate generic content of good quality that is authenticated. This arrangement is presented in Figure 1. It is important to note that this arrangement does not pre-suppose the use of any particular connectivity technology but is neutral in relation to that component.

The generic activities of VASAT partners at various levels are grouped into four: content generation, authentication and storage as granules; training and community needs assessment; facilitating interaction and delivery through rural information hubs; and process for impact assessment (Figure 2). To obtain the advantage of scale, VASAT activities are promoted in the form of value-addition to ongoing and upcoming rural ICT4D sites both in India and Niger. This enables VASAT partners to build on their own strengths, which relate to areas of crop/livestock/water management. Instead of farmers getting in touch with only local experts, an opportunity to create a virtual college of SAT experts has come up. The ICT4D projects in India and the digitally-linked community radio projects in Niger are our first level partners in interacting with primary producers.

In the first year of our active operations, we are in a position to link to about 1200 rural ICT centers in India and to scores of community radio farm groups in Niger. Our approach is to add value to this significant infrastructure and investment by creating highly customized content. A blend of para-professionals operating the rural IT centers and local extension personnel is being created on a pilot scale, with the potential to bridge the current gap in extension communication. With this, we now have an opportunity to reach out to hundreds of thousands of individuals, by creating repositories of authenticated and customizable information.

In the first phase, the VASAT partners in India and Niger have carried out extensive work in mapping the information needs and flows in rural areas. The method followed is based on an adaptation of the Rapid Rural Appraisal (RRA) technique and the

FAO-inspired participatory rural communication appraisal method. The information flow map in rural areas (Figure 3) reveals that the principal sources of information in a rural setting are the rural people themselves. At the secondary level, local input suppliers and traders act as information gateways. The links between farm families and sources of new and critical information in production and marketing are relatively weak. Thus, there is a pressing need to strengthen these links and to supplement them in the immediate term with new channels which rural IT or community radio operations can provide. The information poverty in rural areas has set in a vicious cycle, and a blend of conventional and new channels of communication is needed to help vulnerable families break out of this loop.

Nowhere is this felt more urgently than with water scarcity issues. The participatory appraisals conducted in Andhra Pradesh revealed that an average rural resident is not even aware that drought can be a phenomenon affecting large areas in the vicinity; it is largely perceived as a local event. The first set of information modules of VASAT therefore focuses on coping with drought in its varying degrees.

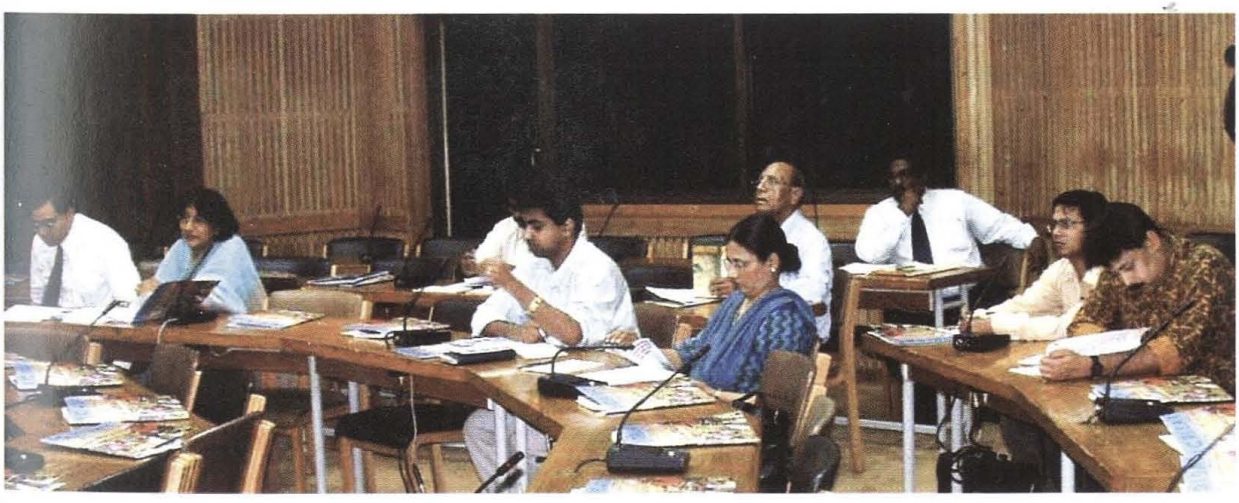
The information modules themselves were developed in a collaborative mode, involving both national and international institutions. National institutions brought in the sensitivity to the context and subject matter expertise, while international institutions contributed their accumulated multi-regional experience and cutting-edge domain knowledge. The modules are split into simple chapters that encourage the user, a woman farmer, for example, to think about the causes and extent of drought. Detailed yet simple scenarios of drought in varying degrees, and potential options for production for a particular scenario follow these. Both crop and livestock production have been covered. Scientists of CRIDA in India, ICRISAT and ILRI made the contributions. An online (e-mail and web-based) process of authentication and review is already in place.

Also in place is a continuous process to obtain responses and feedback from primary users. Without its integration into the core of operations, the program is likely to become supply driven. A sample of primary users pointed out that they were out of any formal instructional experience and that the modules

should not have a bookish quality; instead they should be presented as granules of facts with opportunities to pose review questions! This suggestion has been ingrained in the modules under preparation.

More material is under preparation in partnership mode (Table 1). Both the Indian Institute of Technology (IIT) in Mumbai and IWMI are now engaged in developing water-literacy modules which will be tested with primary users in South India. ICRISAT and CRIDA are now engaged in developing a weather literacy module, focusing on crop-weather relationships. The Indian Institute of Technology in Chennai has come forward to develop simple digital interfaces to gather weather data in their rural IT centers. A dialogue is underway with new generation banks such as the ICICI Bank and with MANAGE, India's premier extension management institute, to supplement the extension workers' information capabilities in relation to drought and water scarcity. A dialogue is underway with leading Open Universities in India such as IGNOU for the rapid generation of instructional material for delivery using their satellite-based infrastructure, and eventual certification of training.

In Niger, current partners relate to community needs assessment and mobilization. A number of leading NGOs, such as Oxfam, work closely with ICRISAT. Regional organizations such as the Centre Africain Applications de la Météorologie pour le Développement (ACMAD; for weather information) and FirstVoice International (offering support for digital radio-based information delivery) are actively involved, along with partner



institutions in the GEF-supported Desert Margins Program. The Niger National Council for Communication is a key partner in helping through community radio stations.

In recent months, ICRISAT, as leader of the VASAT project, has been leading a series of interactions with established leaders in content management and device development. The US National Academy of Sciences has signed an unprecedented agreement with ICRISAT, which acts as a gateway for VASAT coalition partners to access nearly 3000 online publications of the Academy without copyright restrictions. A massive and high quality knowledge resource has thus been created for VASAT this way. ICRISAT and Sun Microsystems, which is an acknowledged global leader in e-learning, have signed an agreement to avail the latter's expertise in learning content management and delivery in a highly customizable form. The Commonwealth of Learning, an intergovernmental organization dedicated to the promotion of non-formal learning in the developing world, is a core partner of VASAT. The upcoming CGIAR Global Open Agriculture and Food University, led by IFPRI, works closely with ICRISAT which provides its gateway services in South Asia.

The VASAT work is gaining momentum, and its relevance has been appreciated by a variety of partners in the coalition. The partners accept that information is the backbone of drought preparedness, and that two-way, interactive communication between farmers and experts can provide relevant information in a timely manner. Opportunities for mass capacity building in new information delivery are unprecedented. VASAT is proving to be the right channel for content and information delivery to primary users, the vulnerable families. It is evident that the power of partnerships blended with the power of contemporary ICT can make a significant contribution to enhancing drought preparedness and food security in the SAT. The ICAR founded in its current form by the late Dr BP Pal has been and will be a source of strength in this endeavor.

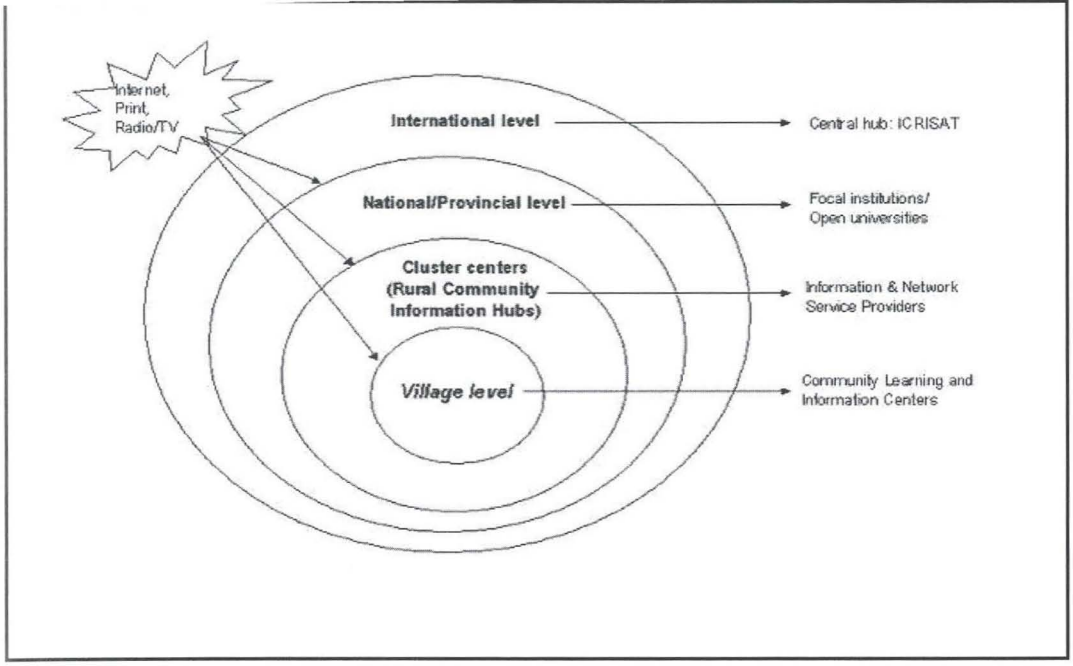


Figure 1. Partners in the VASAT consortium.

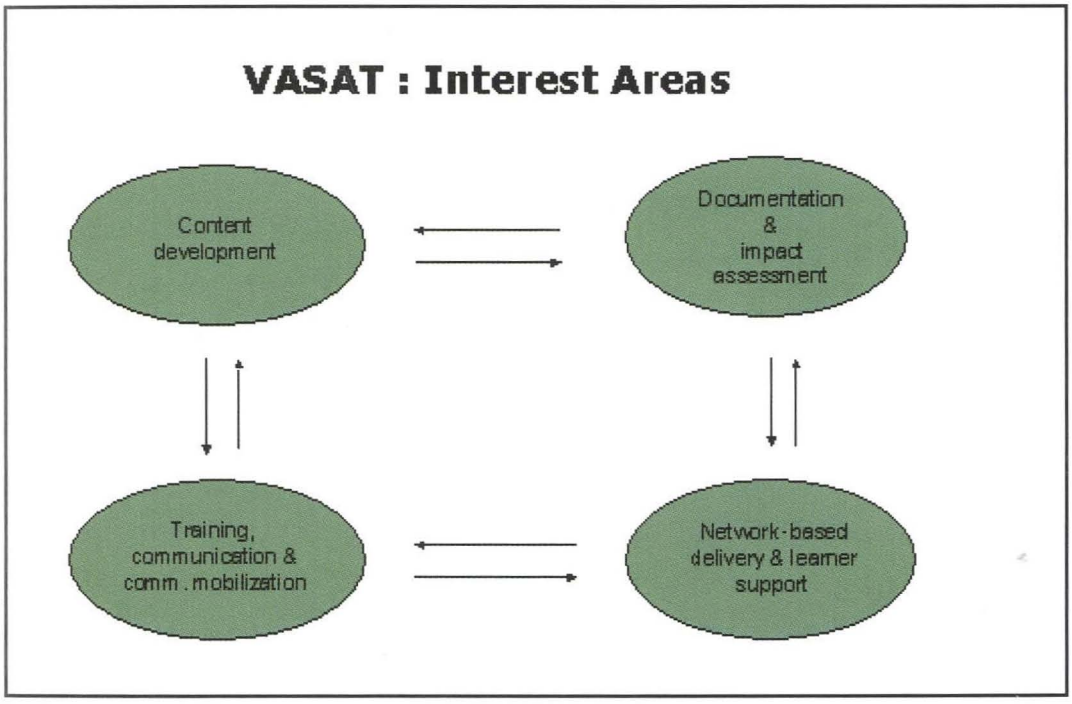


Figure 2. The generic activities VASAT partners are involved in.

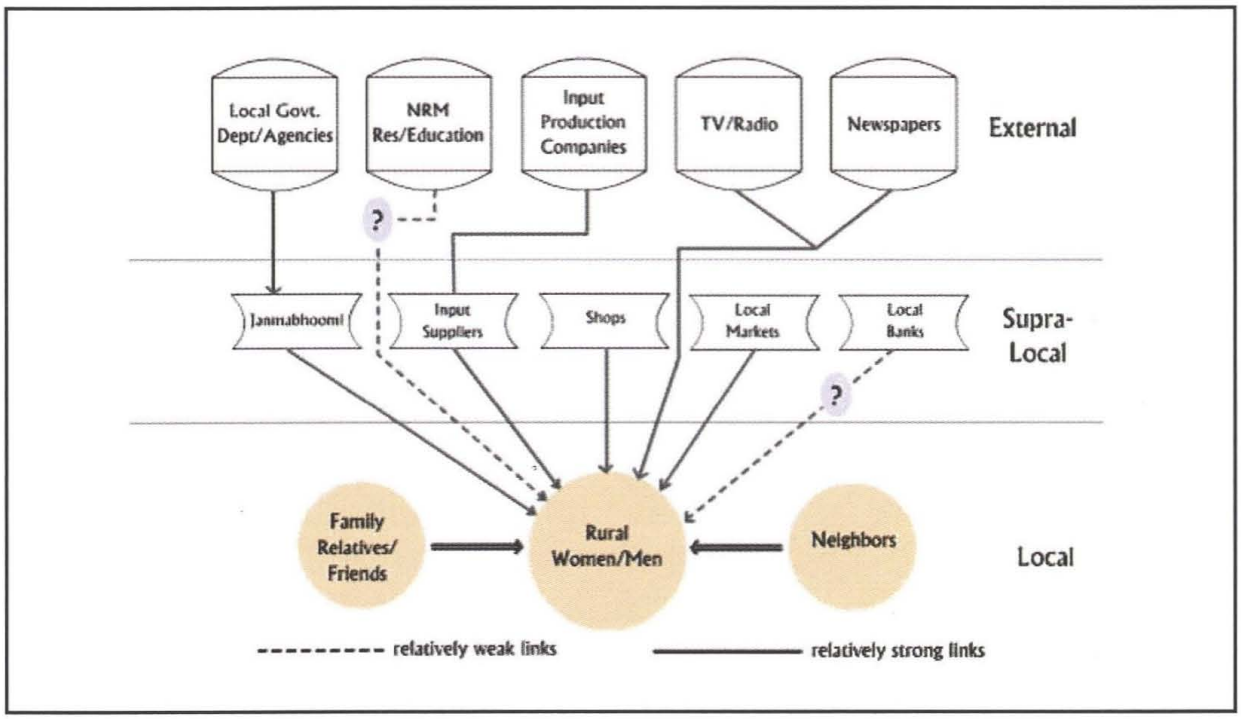


Figure 3. Information flow and linkages in Addakal mandal of Andhra Pradesh, India, as perceived by rural men and women (May 2003).

Table 1. Web-based VASAT content available in simplified format.

Topic	Institutions
Coping with drought	ICRISAT, CRIDA and BRAOU
Micronutrient management	ICRISAT and APRLP
Livestock management during drought	ILRI, CRIDA and ICRISAT
Pests and diseases of chickpea and pigeonpea	ICRISAT
Crop-weather relationship	ICRISAT and CRIDA

Access to Germplasm: ICRISAT's Experience in India*

Paper presented at the International Conference on Agricultural Biotechnology sponsored by the Federation of Indian Chambers of Commerce and Industry (FICCI), 10 August 2004, New Delhi, India

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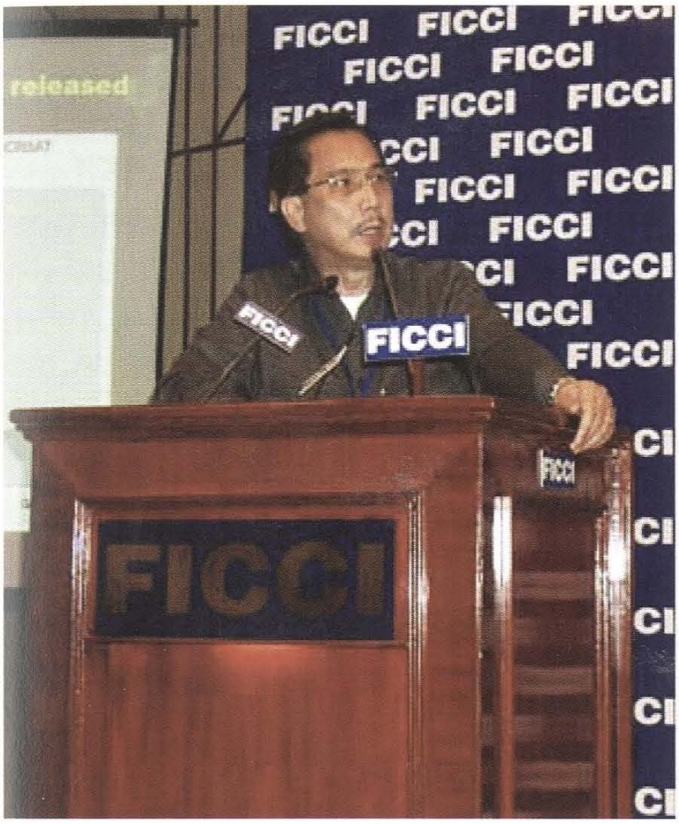
Abstract



Primitive germplasm resources are vital to crop improvement. Therefore, their assembly and access to them are important. The practice of collecting germplasm got an impetus in the 1920s and as a result, there are presently over six million germplasm accessions held in over 1300 genebanks across the world. In this paper, we discuss how one of the CGIAR genebanks has facilitated global access to its germplasm collection. The Rajendra S Paroda Genebank at ICRISAT-Patancheru conserves genetic resources of sorghum, pearl millet, chickpea, pigeonpea, groundnut and six small millets; holding 113,849 accessions of these crops from 130 countries.

India has contributed the maximum number of germplasm accessions from any one country. The genebank has 32,307 accessions of the 11 crops that were received as donations from various institutions in India. Fresh germplasm collections were made (96 missions) which resulted in an additional

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* The paper is co-authored by Dr H Upadhyaya, Special Project Scientist, ICRISAT.

12,515 accessions. The germplasm accessions receive high priority and attention for regeneration, characterization, conservation and distribution. The focus of our research is on diversity assessment and developing representative core and mini-core collections to enhance utilization by breeders. Most of these accessions have been characterized. Germplasm seeds are conserved under very precise (cool and dry) conditions. For each accession, adequate seed quantity is conserved to meet the requests of researchers and for posterity.

The scientists of India are the largest beneficiaries of the ICRISAT genebank. On an average, they have been receiving over 12,000 germplasm samples annually for research. Eleven varieties from the basic germplasm material and 134 varieties and hybrids from breeding materials supplied by ICRISAT have been released for cultivation in India. ICRISAT has almost completed restoring the 44,822 germplasm accessions to the National Bureau of Plant Genetic Resources (NBPGR) which was requested five years ago.

Introduction

Some of the natural resources on earth are finite and vulnerable. The realization of this fact led to the drafting of the Convention on Biological Diversity at the Earth Summit in Rio in 1992. Biological diversity – or biodiversity – refers collectively to the variety of life on earth. Biodiversity forms a "web of life", of which human beings are an integral part and upon which they fully depend. Plants, including food crops, are an important part of this biodiversity, vital for nourishing and sustaining humankind. Biodiversity provides enormous benefits, including aesthetic, cultural, ecological, economic, educational, environmental, genetic, medical, recreational, scientific and social services.

At the Rio Summit, both developed and developing countries formalized their pledge to check the rapid loss of biodiversity

"Eleven varieties from the basic germplasm material and 134 varieties and hybrids from breeding materials supplied by ICRISAT have been released for cultivation in India."

and sustain this critical resource for present and future generations. Plant Genetic Resources (PGR – synonymous with germplasm) are the most important component of this biodiversity. They contribute enormously towards achieving the global objectives of food security, poverty alleviation, environmental protection and sustainable development. They are critical components of plant breeding efforts aimed at increasing food security – both for short-term gains as well as for long-term increase in productivity. The success of crop improvement solely depends on the availability of diverse genetic resources. Although technological advances in plant breeding and agricultural methods have led to dramatic increases in food availability today, it is distressing to know that more than 800 million people in the world still do not have enough food to meet basic nutritional needs.

Historically, there have been several exchanges and introductions of crop germplasm across the globe. However, concerted efforts to explore, collect, exchange and conserve germplasm resources started in the 1920s. Over the years, genebanks have been established in a number of countries and the number of accessions conserved in them now exceeds the six million mark (FAO 1998).

Traditionally, farmers save seeds from one season for planting in the next, and seed storage in genebanks is a recent innovatio Storing seeds under controlled temperatures helps maintain r germination viability:

- *Ex situ* conservation involves seeds stored in genebanks
- *In situ* conservation is done in farmers' fields and in the wild
- *In vitro* conservation is done in laboratory settings.

The CGIAR

Created in 1971, the Consultative Group on International Agricultural Research (CGIAR) is an association of public and private members supporting a system of 15 Future Harvest Centers that work in more than 100 countries to mobilize cutting-edge science, reduce hunger and poverty, improve human nutrition and health and protect the environment.

The CGIAR's mission is to achieve sustainable food security and reduce poverty in developing countries through scientific research and research-related activities in the fields of agriculture, forestry, fisheries, policy and the environment.

The CGIAR seed collections are a unique resource available to all researchers. Seed contributions have helped lay the foundation for recovery by jump-starting agricultural growth in countries emerging from conflict, such as Afghanistan, Angola, Mozambique and Somalia. They have also helped countries recover from natural disasters such as Hurricane Mitch, which struck Honduras and Nicaragua. A recent study showed that of the more than one million seed samples distributed over the past 10 years, the vast majority – 80% or more – went to universities and national agricultural research systems (NARS) where scientists are developing new crop varieties that give higher yields, have improved nutritional value, use less water, need lower amounts of fertilizers and have natural resistance to pests, diseases and climatic vagaries such as drought and floods.

CGIAR and the genebanks

CGIAR scientists play major roles in collecting, characterizing and conserving plant genetic resources. Eleven centers together maintain over 600,000 samples of crop, forage and agroforestry genetic resources in the public domain. Of these, almost 533,000 are designated in trust for the world community under agreements with the United Nations Food and Agriculture Organization (FAO). The terms of the agreements signed between the FAO and CGIAR Centers stipulate that the germplasm within the in-trust collections will be made available without restriction to researchers around the world, on the understanding that no intellectual property protection can be applied to the material. Seed samples are thus made available by individual centers under a standard Material Transfer Agreement (MTA).

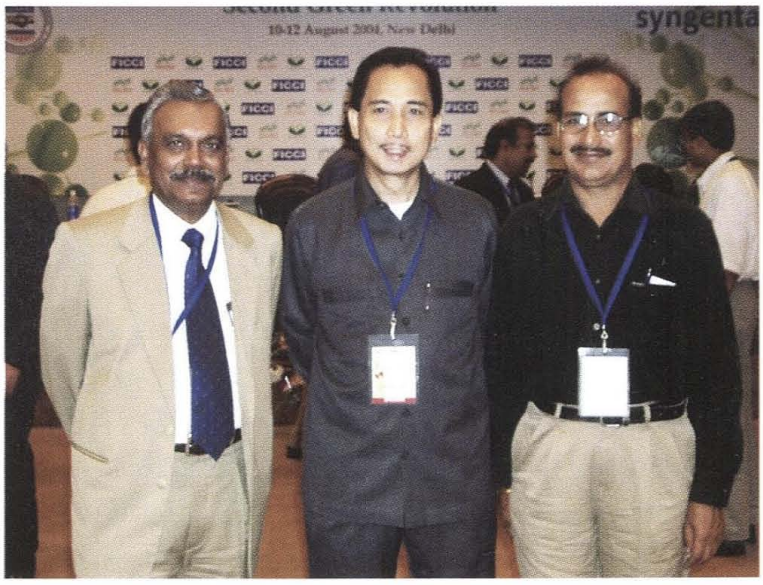
In this paper, we present the germplasm resources at ICRISAT-Patancheru, as an example of a CGIAR genebank, and of how CGIAR Centers have facilitated access to germplasm. ICRISAT has the world mandate for germplasm collection,

characterization and conservation; distribution of sorghum, pearl millet, chickpea, pigeonpea and groundnut; and the genetic enhancement of these crops. ICRISAT also deals with germplasm collection, characterization, conservation and seed distribution of six small millets: finger millet, foxtail millet, kodo millet, little millet, proso millet and barnyard millet. This has enhanced the exchange of germplasm among a number of countries and ICRISAT. This paper describes how India has contributed to building up the germplasm collection at ICRISAT, and how ICRISAT has assisted Indian agricultural research programs in increasing food production and the sustainability of agriculture.

1. Germplasm assembly in the ICRISAT genebank

Soon after the establishment of ICRISAT in 1972, efforts were initiated to assemble germplasm of the mandate crops that existed with various research institutes in India and other countries of the world. In the 1960s, the Rockefeller Foundation was working with the Indian agricultural program on some ICRISAT mandate crops, which became very handy for ICRISAT. The Rockefeller Foundation had assembled over 16,000 sorghum germplasm accessions from major sorghum areas, and ICRISAT acquired 11,961 accessions from this collection in 1974 that existed in India and USA, besides 2000 pearl millet accessions. ICRISAT also obtained 2000 accessions of pearl millet collected by the Institut Français de Recherche Scientifique pour le Développement en Coopération (ORSTOM) in francophone West Africa.

The chickpea and pigeonpea germplasm material originally collected and assembled by the former Regional Pulse Improvement Project (RPIP), a joint project of the Indian Agricultural Research Institute (IARI), the United States Department of



Agriculture (USDA) and Karaj Agricultural University in Iran, formed the initial collection. Sets of this germplasm, which were available in several agricultural research institutes in India and Iran, and at the USDA, were donated to ICRISAT in 1973. ICRISAT also acquired over 1,200 chickpea accessions from the Arid Lands Agricultural Development (ALAD) program in Lebanon. Similarly, much of the groundnut germplasm was received from the Indian groundnut research program [now the National Research Center for Groundnut (NRCG), Junagadh], and USDA. Institutes in India have been particularly supportive of ICRISAT. In all, 32,307 accessions (sorghum 12,042; pearl millet 3,320; chickpea 5,401; groundnut 5,054; pigeonpea 3,889; and small millets 2,601) were donated by various research institutes in India. This comprises 28.3% of the entire holding in the ICRISAT genebank (Table 1).

ICRISAT initiated activities to add new germplasm of its mandate crops from the area of genetic diversity or from areas that were not adequately represented in the germplasm collection. Between 1975 and 2003, a total of 96 joint missions were launched in India. As a result, 12,515 accessions (sorghum 2,595; pearl millet 3,869; chickpea 2,087; pigeonpea 2,099; groundnut 1,006; and small millets 859) were collected (Table 2). ICRISAT also works on the genetic improvement of its mandate crops. In this process, a large number of breeding lines or germplasm selections are developed and evaluated at important locations. The promising/improved germplasm lines were also registered in the genebank and conserved for future utilization. Currently, 3,905 accessions (sorghum 549; pearl millet 1,336; chickpea 286; pigeonpea 1619; groundnut 114; and finger millet 1) have been registered in our genebank (Table 3). Several institutes have contributed to building up the germplasm collection at ICRISAT. The 15 Indian institutes that donated a substantial number of germplasm samples are listed in Table 4.

2. Germplasm management

Phenotypic characterization and evaluation: Agronomic and morphological characterization is necessary to facilitate the utilization of germplasm. Evaluation of germplasm accessions for traits of agronomic importance enhances their utility to

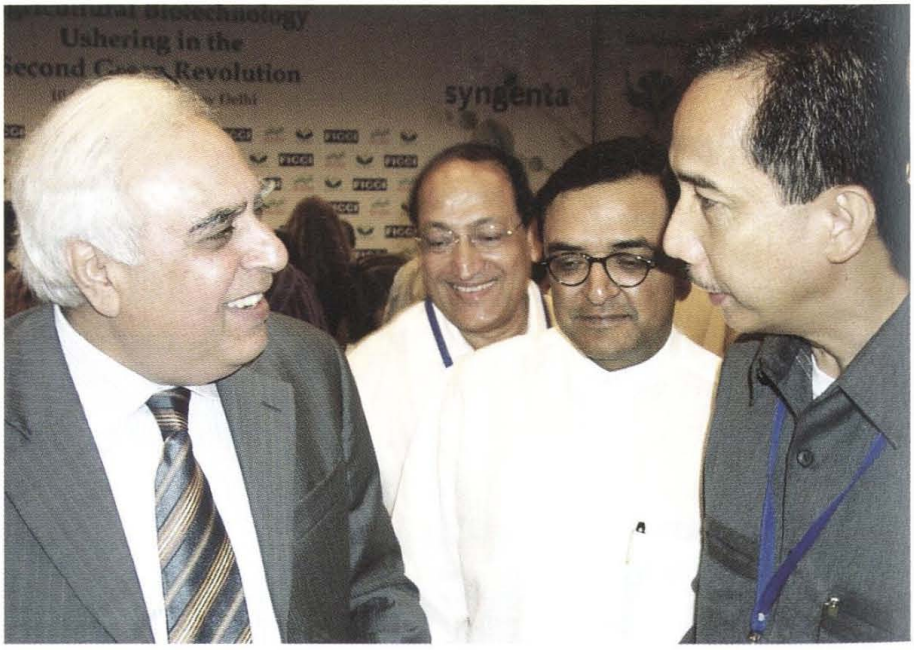
research workers. To achieve this, germplasm accessions of all the crops were sown in batches over the years and characterized for morphological and agronomic traits. Germplasm screening against biotic and abiotic stresses were conducted in collaboration with various disciplinary scientists. Grains were tested for nutritional value such as starch, protein, oil content, cooking time, etc. Germplasm sets were evaluated over locations jointly with NARS scientists in India, Nepal, Thailand, Indonesia, Ethiopia, Kenya and more intensively with NBPGR, India. Results of joint evaluations have led to a better understanding of the germplasm material.

Regeneration: Regenerations were carried out to meet increased seed requirements of (1) accessions that had reached a critical level of seed stock/viability; (2) accessions required for medium-term storage (MTS) or long-term storage (LTS); and (3) germplasm repatriation, particularly to the NBPGR. Some of the germplasm accessions that do not produce seeds under climatic conditions prevailing in ICRISAT-Patancheru (some wild *Arachis* species) are maintained vegetatively in the greenhouse. Some other accessions (wild *Cicer* species) need long day length and cool weather to grow and produce seeds. These species are also regenerated in greenhouse facilities.

Conservation: Germplasm conservation requires cleaning the seed material, drying to minimal seed moisture content, storing in cool and dry conditions and regular monitoring of seed health during storage. The entire collection of seeds in the ICRISAT genebank is stored in medium-term storage (MTS 4^0C, 20–30% RH) in aluminum cans. Recent monitoring of the health of seed conserved for 10–25 years (MTS) indicated greater than 75% seed viability for the majority of the accessions. Accessions with declining seed viability (less than 75% seed germination) are regenerated on priority and old stock is replaced with fresh seeds. Germplasm accessions are also conserved in long-term storage (LTS -20°C) after packing in vacuum-sealed aluminum foil pouches. Before packing, the seeds are dried to about 5% moisture content in a walk-in-drying room (100 m^3 size; 15°C and 15% RH) facility. At present, about 70% of the FAO designated germplasm is in the LTS facility.

Enhancing use of germplasm in research to improve food security: Only a very small proportion of the collection is being used by plant breeders in crop improvement programs. This is because of the lack of information on traits of economic importance, which often show genotype x environment interactions and require replicated multilocational evaluations. This is a very costly and resource-demanding task owing to the large size of the germplasm collection. To overcome this, our research now focuses on studying the diversity of germplasm collection and developing "core collections" which are about 10% of the entire collection, but represent almost the full diversity of the species. In crops with a large number of accessions and large core subset too, ICRISAT scientists have developed a strategy to select a mini-core collection (Upadhyaya and Ortiz 2001). The mini-core collection is 10% of the core collection (ie, 1% of the entire collection) and contains the useful diversity of the entire collection. From the germplasm collection in the ICRISAT genebank, we have already developed a core collection of sorghum (2,447 accessions, Grenier et al. 2001); pearl millet (1,600 accessions, Bhattacharjee 2000); chickpea (1,956 accessions, Upadhyaya et al. 2001); groundnut (1,704 accessions, Upadhyaya et al. 2003); and pigeonpea (1,290 accessions, Reddy et al. In press). We have also selected mini-core collections of chickpea (211 accessions, Upadhyaya and Ortiz 2001) and groundnut (184 accessions, Upadhyaya et al. 2002).

Development of the core and mini-core collections has spurred scientists in different countries, including India, to use more germplasm for research. A large number of mini-core collection sets



of chickpea and groundnut have been sent on request to different countries. The core and mini-core collections are evaluated and useful parents are selected for use in breeding programs. We have identified 21 new sources of early maturity, 158 sources of low temperature tolerance at germination, 18 sources of drought resistance – related traits, specific leaf area and SPAD chlorophyll meter reading in groundnut and 29 sources of early maturity, 16 sources of large seed size in kabuli type and 10 sources of drought resistance traits in chickpea. We also identified 15 valencia, 20 spanish and 25 virginia-type germplasm lines in groundnut with high yield, good shelling percentage and 100-seed weight through multilocational evaluation of the Asia region core collection. These new sources performed better than or similar to the best control cultivars for particular trait(s) but were diverse from the known sources. Their use will broaden the genetic base of cultivars. Similarly, the chickpea mini-core collection developed at ICRISAT (211 accessions) was evaluated at the Indian Institute of Pulses Research (IIPR), Kanpur, during the 2003–2004 season to identify desirable germplasm for use in improvement programs. Scientists of the institute are very enthusiastic about this set of germplasm. They have selected 12 accessions for subsequent large plot evaluation. Of these, six, namely ICCs 14194, 14196, 14197, 14199, 12034 and EC 381882 have already been involved in hybridization to develop large-seeded kabuli types. This will help in broadening the genetic base of the cultivars.

Molecular characterization of germplasm

Characterization of germplasm with molecular markers can help improve their utilization. The information gained can be used to predict shared pedigree or the geographical origin of individuals and to find population structures that influence the analysis of functional characterization, such as associations between markers and phenotypes. It can further form the basis for mining and cloning agronomically important genes.

ICRISAT has a well-equipped high throughput genomics laboratory, named the MS Swaminathan Applied Genomics Laboratory. Efforts are being made to assess structural and

functional diversity in selected subsets of the germplasm of ICRISAT mandate crops using molecular markers.

Chickpea: Two sets of germplasm have been analyzed for molecular diversity. The first set comprised 96 accessions (resistant, moderately resistant and susceptible to ascochyta blight) and the second set comprised 89 accessions (resistant, moderately resistant and susceptible to botrytis gray mold). The molecular diversity in these sets was assessed by studying polymorphisms at about 30 mapped simple sequence repeats (SSR) markers. The number of alleles detected per marker ranged from 7 to 32. The genetic relationships among genotypes within each set indicated that the sources of resistance for each of these diseases might be genetically diverse. This information will be of use when choosing parental genotypes for pyramiding different sources of resistance in breeding materials.

ICRISAT is actively participating in the Generation Challenge Program (Generation-CP) launched by the CGIAR aimed at enhancing the use of genetic resources through application of biotechnological tools. The mini-core collection of chickpea (211 accessions) and a representative set (57 accessions) of the unique germplasm accessions available at the International Center for Agricultural Research in the Dry Areas (ICARDA) along with 20 accessions of the two closely related wild species (*Cicer reticulatum* and *C. echinospermum*) are being analyzed for a set of 50 molecular markers.

Groundnut: Twenty-three SSR and three resistance gene analogue (RGA) markers were screened across 22 genotypes with differing levels of resistance to rust and late leaf spot. Twenty-four markers were polymorphic and 12 of these showed high levels of polymorphism. This is the first instance of such high levels of genetic polymorphism in cultivated groundnut. Multi dimensional scaling and cluster analyses revealed three well separated groups of genotypes, corresponding to different botanical types and disease response groups.

In another study, 36 SSR markers were used to assess the degree of molecular polymorphism between 46 genotypes exhibiting resistance to bacterial wilt. A total of 107 alleles were detected, of which 101 were polymorphic. Multi dimensional scaling and cluster analyses revealed two distinct groups within the germplasm broadly corresponding to the two subspecies (*hypogaea* and *fastigiata*) of *A. hypogaea*.

These molecular diversity analyses provide valuable information for groundnut breeders designing strategies for incorporating and pyramiding diverse sources of resistance and for molecular biologists wishing to create recombinant inbred line populations to map these traits.

Documentation: The vast germplasm data gathered on chickpea and pigeonpea germplasm has been summarized and presented to users in the form of catalogs (Pundir et al. 1988, Remanandan et al. 1988). During the last 15 years, we have had a very purposeful collaboration with NBPGR, India, on germplasm exploration and this is being evaluated at a number of potential locations. The success stories were reviewed, discussed and published (ICRISAT 1989). The data on joint germplasm evaluations were analyzed and we published two catalogs on forage sorghum germplasm (Mathur et al. 1991, 1992), one on chickpea (Mathur et al. 1993a) and two on pearl millet (Mathur et al. 1993b and 1993c). Core and mini-core collections of ICRISAT crops were established and the information was published for the benefit of fellow research workers.

Germplasm supply to scientists in India

India has contributed immensely towards the growth of the germplasm collection in the ICRISAT genebank. In return, scientists from Indian institutes have been the largest recipients of the seeds. Since the inception of the institute, 372,675 germplasm samples have been supplied (Table 5) in response to thousands of indents from institutions/scientists based in India. In addition, ICRISAT scientists have shared very large samples of early and advanced generation breeding materials, international nurseries and trials with their counterparts.

Impact of germplasm supplied to Indian NARS

Besides the utilization of germplasm in ongoing research at other institutes, 11 germplasm accessions (sorghum 6, pigeonpea 2 and 1 each of chickpea, pearl millet and small millet) supplied from the ICRISAT genebank have been directly released as cultivars in India. They have greatly benefited Indian agriculture. Pigeonpea germplasm accession ICP 8863 collected from farmers' fields in India was found very promising against fusarium wilt and was purified for the trait. The purified line was found to be high yielding and it was released in 1986 as Maruthi for cultivation in Karnataka State, India. This variety is grown on large hectarage in the adjacent States of Maharashtra and Andhra Pradesh. The value of benefits from ICP 8863 were estimated at US$61.7 million by 1996, with a 65% internal rate of return.

Parbhani Moti, a sorghum variety, was released in Maharashtra in May 2002. This variety is an excellent maldandi type (predominant postrainy sorghum landrace in Maharashtra and Karnataka) with large lustrous grains and high yield. It has been selected from a germplasm collection from Ghane Gaon, Sholapur, Maharashtra, made by ICRISAT genebank staff during 1989.

Another example is the release of a barnyard millet variety (PRJ 1) in Uttaranchal State during 2003. This variety yielded 45.4%

higher grain yield compared to the check variety VL 29. It provides substantial fodder yield as well. The variety is a selection from the ICRISAT germplasm collection IEC 542 that originated in Japan.

In addition, scientists from ICAR institutions and state agricultural universities in India have released 134 varieties (sorghum 21, pearl millet 58, chickpea 32, pigeonpea 12 and groundnut 11) selected from breeding material provided by ICRISAT. The benefits from these varieties have been substantial. For example, the chickpea variety ICCV 10 released in Gujarat State produced 84% higher income compared to the local varieties. Chickpea varieties released in Andhra Pradesh and Maharashtra have yielded an additional income of US$55 and US$80 per hectare, respectively. The first pigeonpea hybrid (ICPH 8) is now under commercial production in India and it gives about 25% higher yield. Groundnut varieties ICGS 44 and ICGV 86564 are making great impact in the southern States and in Gujarat. At present, 60% of the pearl millet in India comprises hybrids. Seventy hybrids are being cultivated, of which 60 have been developed from ICRISAT-supplied research materials.

Repatriation of germplasm to Indian NARS

The germplasm collections maintained in the RS Paroda Genebank include 44,822 accessions (sorghum 14,637; pearl millet 7,189; chickpea 7,488; pigeonpea 5,988; groundnut 6,060; and small millets 3,460) received from or jointly collected with Indian national programs. In 1998, NBPGR requested ICRISAT to restore this entire collection. As of July 2004, ICRISAT has repatriated 43,913 accessions (98% of the request). Thus, the Indian NARS have regained their precious heritage that was conserved in the ICRISAT genebank.

References

Bhattacharjee R. 2000. Studies on the establishment of a core collection of pearl millet (*Pennisetum glaucum*). Ph D thesis, CCS Haryana Agricultural University, Hissar 125 004, India. 162 pp.

FAO (Food and Agriculture Organization of the United Nations). 1998. The state of ex-situ conservation. Page 90 *in* The state of the world's plant genetic resources for food and agriculture. Rome, Italy: FAO.

Grenier C, Bramel PJ and **Hamon P.** 2001. Core collection of the genetic resources of sorghum: 1. Stratification based on eco-geographical data. Crop Science 41:234–240.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1989. Collaboration on genetic resources: summary proceedings of a joint ICRISAT/NBPGR (ICAR) workshop on Germplasm exploration and evaluation in India, 14–15 Nov 1988, ICRISAT, Patancheru, India. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Mathur PN, Prasada Rao KE, Singh IP, Agrawal RC, Mengesha MH and **Rana RS.** 1992. Evaluation of forage sorghum germplasm, Part 2: NBPGR-ICRISAT Collaborative Programme. New Delhi, India: NBPGR. 296 pp.

Mathur PN, Prasada Rao KE, Thomas TA, Mengesha MH, Sapra RL and **Rana RS.** 1991. Evaluation of forage sorghum germplasm, Part 1: NBPGR-ICRISAT Collaborative Programme. New Delhi, India: NBPGR. 269 pp.

Mathur PN, Pundir RPS, Patel DP, Rana RS and **Mengesha MH.** 1993a. Evaluation of chickpea germplasm, Part 1: NBPGR-ICRISAT Collaborative Programme. New Delhi, India: NBPGR. 194 pp.

Mathur PN, Rao SA, Agrawal RC, Mengesha MH and **Rana RS.** 1993b. Evaluation of pearl millet germplasm, Part 1: NBPGR-ICRISAT Collaborative Programme. New Delhi, India: NBPGR. 200 pp.

Mathur PN, Rao SA, Sapra RL, Mengesha MH and **Rana RS.** 1993c. Evaluation of pearl millet germplasm, Part 2: NBPGR-ICRISAT Collaborative Programme. New Delhi, India: NBPGR. 215 pp.

Pundir RPS, Reddy KN and **Mengesha MH.** 1988. ICRISAT chickpea germplasm catalog: Evaluation and analysis. ICRISAT, Patancheru, India. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 94 pp.

Reddy LJ, Upadhyaya HD, Gowda CLL and **Sube Singh.** (In press.) Development of core collection in pigeonpea (*Cajanus cajan* [L.] Millsp]. Genetic Resources and Crop Evolution.

Remanandan P, Sastry DVSSR and **Mengesha MH.** 1988. ICRISAT pigeonpea germplasm catalog: Evaluation and analysis. ICRISAT, Patancheru, India. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 89 pp.

Upadhyaya HD, Bramel PJ, Ortiz R and **Sube Singh.** 2002. Developing a mini core of peanut for utilization of genetic resources. Crop Science 42:2150–2156.

Upadhyaya HD, Bramel PJ and **Sube Singh.** 2001. Development of a chickpea core subset using geographic distribution and quantitative traits. Crop Science 41:206–210.

Upadhyaya HD and **Ortiz R.** 2001. A mini core subset for capturing diversity and promoting utilization of chickpea genetic resources. Theoretical and Applied Genetics 102:1292–1298.

Upadhyaya HD, Ortiz R, Bramel PJ and **Sube Singh.** 2003. Development of a groundnut core collection using taxonomical, geographical and morphological descriptors. Genetic Resources and Crop Evolution 50:139–148.

Table 1. Germplasm accessions donated by institutes in India until 2003 in the RS Paroda Genebank at ICRISAT.

Crop	Number of accessions
Sorghum	12,042
Pearl millet	3,320
Chickpea	5,401
Pigeonpea	3,889
Groundnut	5,054
Small millets	2,601
Total	32,307

Table 2. Number of germplasm accessions in the ICRISAT genebank jointly collected with Indian scientists from farmers' fields in India, 1975-2003.

Crop	Number of accessions
Sorghum	2,595
Pearl millet	3,869
Chickpea	2,087
Pigeonpea	2,099
Groundnut	1,006
Small millets	859
Total	12,515

Table 3. Germplasm accessions in the ICRISAT genebank that were bred/developed/selected at ICRISAT until 2003.

Crop	Number of accessions
Sorghum	549
Pearl millet	1,336
Chickpea	286
Pigeonpea	1,619
Groundnut	114
Finger millet	1
Total	3,905

Table 4. Institutions in India that donated a large number of germplasm to ICRISAT, 1973–2003.

Institution	Sorghum	Pearl millet	Chickpea	Pigeonpea	Groundnut	Small millets	Total
AICSIP, Hyderabad	175	-	-	-	-	-	175
AICRPO, Hyderabad	-	-	-	-	529	-	529
ANGRAU, Hyderabad	115	-	-	3,035	1,366	285	4,801
ARS, Niphad, Maharashtra	-	-	345	-	-	-	345
GAU, Junagadh	-	66	-	-	1,167	-	1,233
GBPUAT, Pantnagar	-	155	96	-	-	-	251
HAU, Hisar	-	-	211	-	-	-	211
IARI, New Delhi	33	-	3,022	174	-	-	3,229
JNKVV, Jabalpur	-	164	127	479	-	-	770
MPKV, Rahuri	-	234	173	191	267	-	865
NBPGR, New Delhi	90	170	149	-	161	469	1,039
PAU, Ludhiana	-	106	1,029	-	496	-	1,631
RAU, Samastipur, Bihar	-	-	-	-	197	-	197
TNAU, Coimbatore	13	45	63	40	590	531	1,282
Rockefeller Foundation (India)	11,370	2,022	-	-	-	1,246	14,638
Total	11,796	2,962	5,215	3,919	4,773	2,531	31,196

Table 5. Distribution of germplasm samples from the ICRISAT genebank to Indian research institutes, 1974-2003.

Crop	1974-83	1984-93	1994-2003	Total
Sorghum	21,237	85,701	19,174	126,112
Pearl millet	9,145	43,423	6,676	59,244
Chickpea	19,678	28,585	17,221	65,484
Pigeonpea	13,482	20,395	11,309	45,186
Groundnut	12,936	21,600	9,342	43,878
Small millets	13,574	7,496	11,701	32,771
Total	90,052	207,200	75,423	372,675

CGIAR-National Collaboration on Open and Distance Learning for Agriculture*

Delivered during the Dialog with Partners on Global Open Agriculture and Food University (GO-AFU) of the CGIAR, 26 August 2004, Washington DC, USA

My dear colleagues, good afternoon.

On behalf of ICRISAT, let me first express my full support to this novel initiative of establishing a Global Open Agriculture and Food University (GO-AFU). In this era of serious funding challenges and a strong demand for building national capacity for agricultural research, innovative schemes like GO-AFU are indeed very relevant.

By ensuring access to information, knowledge and cutting-edge technologies, especially by national systems, I firmly believe that GO-AFU will serve as a catalyst for a second Green Revolution.

During the last ten years, Open and Distance Learning (ODL) has emerged as a significant sector in higher education in developed countries. Many universities no longer discriminate between distance and regular courses while awarding degrees. However, the cost of developing courseware and its validation are not low. Likewise, online course management systems are still expensive.

On the other hand, some developing countries are considering the introduction of ODL into their current academic programs. This is mainly due to the high cost of keeping students on campus, and the rapidly rising demand for graduate education that cannot be met by conventional universities.

Within this context, the potential of ODL in accelerating the reach of postgraduate education can be optimized by the CGIAR through GO-AFU. The credo of CGIAR's ICT-KM Program

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* Delivered by Dr Rex L Navarro, Head, Communication Office, on behalf of Director General William D Dar.

on communication, collaboration and creativity, faithfully describes the mode of partnerships for GO-AFU.

First of all, GO-AFU will break communication barriers among CGIAR Centers, national systems and stakeholders to fully mobilize science and technology. Secondly, it will facilitate international collaboration to help improve the quality of instruction in regional and national universities, especially those in Asia and sub-Saharan Africa. It will also work closely with CGIAR Centers and the Commonwealth of Learning (COL) to develop modules, establish a global repository of learning objects and deliver collaborative degree programs. Thirdly, GO-AFU will develop creative mechanisms where our national partners and stakeholders can easily access our repository of learning objects and adapt these to their own needs.

Before GO-AFU was conceived, we established the Virtual Academy for the Semi-Arid Tropics (VASAT) together with our sister centers IWMI, ILRI and ISNAR and a number of national partners. I would also like to acknowledge the strong support of COL in this initiative.

The cornerstone of VASAT is cooperative content development and creation. Let me share some of our initial experiences:

1. Content development and validation are being done with ILRI, IWMI and other international knowledge centers across Asia and Africa
2. Collaborative content development has been done with and for national agricultural research and extension systems
3. Demand-driven content has been developed from available subject matter and world class expertise
4. Agreements are in place for copyright-free content sharing with advanced research institutes like IRI and NOAA
5. Landmark partnerships have been forged with the US National Academy of Sciences and Sun Microsystems

"The credo of CGIAR's ICT-KM Program on communication, collaboration and creativity, faithfully describes the mode of partnerships for GO-AFU."

6. Participation in the CG-OLR project in applying global standards for content storage and classification
7. Agreements with leading international ODL promoters like COL to set global standards in instructional design
8. Partnerships with leading open universities and development agencies for content delivery, adaptation and quality control.

During the last three decades, ICRISAT has been working closely with more than 100 universities in Asia and sub-Saharan Africa. Throughout these years, we worked together to train students, develop programs and strengthen national capacity in agricultural research. In spite of this, we feel that there is need for further innovation in order to reach more stakeholders at a lesser cost. Hence, VASAT was born. VASAT will be a strong complement to GO-AFU as it focuses on non-degree programs for farm communities and their intermediaries in the semi-arid tropics.

I congratulate IFPRI for the spadework done in conceptualizing GO-AFU. I also thank IFPRI for designating ICRISAT and IGNOU as nodal points for GO-AFU in South Asia, and giving us the opportunity to facilitate learning needs assessment in Southeast Asia.

In summary, let me emphasize GO-AFU as a new opportunity for CGIAR to play a bridge-building role among educational institutions in the North and South, and among national systems in the South. It also offers new possibilities for using research-generated content to support national capacity building. Thus, content generation should be in virtual and cooperative mode. Lastly, costs should be lowered continuously with a phased introduction of ICT in content delivery.

It is time for the CGIAR and its national partners to collaborate towards innovative knowledge sharing to fully mobilize science and technology on behalf of the poor.

GO-AFU is one of the best mechanisms to make this happen.

Thank you and good day.

Strategic Partnerships and Alliances: Key to Effective Planning, Research and Development in Agriculture in South Asia

Delivered at the ICRISAT-ADB regional workshop, 1-3 September 2004, New Delhi, India

Ladies and gentleme good day.

On behalf of ICRISAT, or of the organizers, allo me to thank you for r sponding to our invitatio and to warmly welcom you to this importa workshop for South Asi This workshop w strengthen our existi partnerships and allianc to be more effective in i fluencing the growth a development of agricu ture in South Asian cou tries. As we know, th meeting is an initiative the Asian Developme Bank, a prestigious institution dedicated to supporting the r gion.

The objective of this workshop is to identify practical options more effective partnership and information exchange betwe stakeholders in agricultural sector planning, research a development. You are the representatives of such sectors, a are therefore best equipped to contribute to the 'think-ta from which meaningful, practical and sustainable solutions a best practices will emerge.

The global Millennium Development Goals (MDGs) provide a shared vision of a much improved world by 2015; where extreme poverty is cut to half, child mortality is greatly reduced, gender disparities in primary and secondary education are eliminated; women are more empowered and health and environment indicators improve within a global partnership for development. I repeat, within a global partnership for development.

We know that we can contribute to some or all of these goals, each in his or her own way. We are fortunately in an advantageous position in terms of skills, technologies and decision making powers to be part of this global partnership for development. We know from experience that the whole is greater than the sum of its parts. What needs to be addressed are the gaps in our partnerships and alliances. How can we complement each other so that no aspect goes unnoticed? How can we complement each other so that we can become influential instruments of change?

We are all of us experts of one kind or another in matters of agriculture and related fields. Agricultural development has been going on for centuries and we need to be in tune with the challenges of the times. Times change, situations change, population is growing, available resources are shrinking, and every generation inherits the responsibility of finding solutions to cope with the challenges of food security, land degradation, water shortages, access to markets and empowerment of the poor. Innovation then, is the need of the hour.

For this workshop on "Strengthening partnerships for strategic planning, research, and development in agriculture", we seek institutional innovations that effectively link research and the national development process. This, we feel, will truly involve agricultural research that is demand driven as well as problem oriented.

"We know from experience that the whole is greater than the sum of its parts. What needs to be addressed are the gaps in our partnerships and alliances."

In our search for ways to enhance partner power, we can further ask: What are examples of institutional innovations? How do national and international agricultural research and development organizations galvanize alliances or coalition building with other development partners? And what are the gaps in the process and the barriers to partnership? Organizations like yours and mine need to adapt, innovate and evolve. Let me share with you some of the innovations we have introduced at ICRISAT.

Much has changed since ICRISAT was established in 1972. Merely increasing food production does not reduce poverty. No one can do it alone, and ICRISAT recognizes the need for a development paradigm that builds stronger stakeholder participation, partnership and governance. The public sector as the main source of technological innovation has been supplemented by the private sector, in both the seed industry and related areas of biotechnology and life sciences. In response to these changes ICRISAT has now re-oriented both its programs and its approach to partnership.

In January 2000, one of my first tasks on assuming office at ICRISAT was to sign an agreement with a consortium of private seed companies to fund hybrid parents research – an almost unique innovation in the CGIAR.

ICRISAT also entered into an agreement with a major rural development project – the Andhra Pradesh Rural Livelihoods Project, funded by DFID, which has cemented a new type of relationship between scientific research on watershed development and natural resource management. Such a link between an international agricultural research institute and a major rural development program is a key institutional innovation.

ICRISAT is now in the bridge, broker, catalyst paradigm where scientists develop stronger partnership-building skills in addition to their scientific credentials. The innovation concept is spreading, and new opportunities that catalyze the excitement of all research partners and donors should be explored.

Every partner brings along his/her own evolution and innovation. We must share our values and principles, and

continue to develop mutual trust, respect and transparency with our partners while maintaining excellence in our science. Let us not forget our ultimate goal to improve the livelihoods of the rural poor, especially the farmer whose main and sometimes only goal is to reap the benefits of what is sown. Let us sincerely perform *science with a human face*. And we can also say, let's pursue sustainable development with a human face.

The best way forward to ensure that we achieve impacts is to partner with a range of stakeholders – the private and public sector, civil society organizations and the donor community – always keeping our focus fixed on the people and farmers we serve.

I wish you honest and open deliberations and a successful workshop. I close by paraphrasing the words of the famous Indian poet and thinker Rabindranath Tagore:

"Where the mind is without fear and the head is held high, where knowledge is free, where tireless striving stretches its arms towards perfection, where the clear stream of reason does not bury itself in the dreary desert sand of dead habit.... into that heaven of freedom, let our people awake." Applying this to the region, let South Asia prosper with all of us working as one.

Thank you.

Partnership is the Key to Developing Pearl Millet Cultivars

Welcome speech at the Pearl Millet Scientists' Field Day, 20 September 2004, ICRISAT, Patancheru, Andhra Pradesh, India

Good morning ladies and gentlemen!

I am pleased to welcome you all on the occasion of this Pearl Millet Scientists' Field Day. My special welcome to many of those from outside ICRISAT who had to travel long distances to be here; and to the Pearl Millet Hybrid Parents Research Consortium members, consisting of seed companies and the Sehgal Family Foundation.

This Field Day comes after four years; the previous one was held in the year 2000. I am sure that during these years, most of you involved in pearl millet research continued your interaction, in terms of exchange of ideas, research results and breeding materials. What has been organized for today and tomorrow when it comes to selection and exchange of breeding materials is significant – which is the main purpose of this Field Day.

It is a matter of great satisfaction to see an impressive growth in ICRISAT's research partnership with pearl millet scientists in national research programs under the umbrella of the ICAR-

ICRISAT Partnership Research Project on this crop. I am convinced that this strengthening of research partnership will go a long way in increasing pearl millet productivity, and hence contribute to the well-being of those farming communities who heavily depend on this crop for their livelihoods.

Similarly, during the last four years, there has been an impressive growth in ICRISAT-private sector partnership as well. You are all aware of the ICRISAT-Private Sector Hybrid Parents Research Consortium on Pearl Millet and also on Sorghum that were started in the year 2000. The number of seed companies in the Pearl Millet Consortium has substantially increased from 7 in 2000 to 22 this year. This is a landmark in ICRISAT's partnership-based hybrid parents' research on pearl millet involving the private sector.

This partnership has considerably strengthened ICRISAT's pearl millet research and product delivery capability, which, in turn, I believe, has strengthened the research and development programs of the NARS and the private sector in India. The enormous on-farm hybrid cultivar diversity with more than 70 hybrids presently under cultivation, and significant grain yield increases are testimony to productive partnerships that ICRISAT continues to have with you all in the national program and the private sector. The products of this research (both improved breeding materials and information) are also likely to have significant spillover effects on pearl millet research programs elsewhere in the world.

While we have been convinced of the power of conventional plant breeding in delivering goods, we are also won over as I hope you all are, by the new science tools that can make significant contributions to enhancing the pace and precision of plant breeding. These new tools are increasingly becoming an integral part of plant breeding.

"The number of seed companies in the Pearl Millet Consortium has substantially increased from 7 in 2000 to 22 this year."

In the case of pearl millet, let me cite an example of a biotechnological tool where successes have already been achieved. The reference here is to molecular marker-assisted gene deployment for resistance to downy mildew, the most dreaded disease of pearl millet, especially hybrids. The partnership approach to this problem has now led to the development of downy mildew-resistant versions of the earliest-maturing hybrid HHB 67, which is currently grown on more than 0.4 million ha in some of the driest parts of Haryana and Rajasthan. These new resistant versions of the hybrid can now extend the commercial life of this novel hybrid and save millions of dollars for the farmers.

Similar successes with breeding for downy mildew resistance in other commercial hybrids are likely in the near future. The same technology is being applied to improve drought tolerance of commercial hybrids. The successes of such research efforts depend on the quality of research that is achieved through collaboration, in which you all are increasingly becoming active partners. This is a good development indeed.

At this stage, I would like to make a mention of another biotechnological approach to crop improvement, ie, transgenic

technology. Application of this tool has led to the development of the world's first transgenic groundnut with resistance to Indian peanut clump virus; and the world's first transgenic pigeonpea with resistance to *Helicoverpa* pod borer. Development of these transgenics has been possible due to partnerships with advanced research institutes and the private sector. Evaluation of the transgenic cultivar versions can best be done with scientists like you who are engaged in legumes research.

You may think of additional research areas that require strengthening of our partnerships, such as breeding and commercializing pearl millet as a fodder and feed grain crop, and traits and selection criteria that should be used to effectively address them. Recently, we initiated research in two new areas. One relates to breeding for salinity tolerance and the other to breeding for higher levels of micronutrients, especially iron, zinc and beta-carotene. Nutritionists have found the deficiency of these micronutrients most widespread, and particularly critical in the diets of those in the dry areas, typical of the arid and semi-arid tropics. There is much to gain for all by attacking these problems through partnership research.

All of you from various pearl millet programs in India have provided the benefit of your expertise and experience to our ICRISAT colleagues engaged in pearl millet research to make their research objectives, strategy and methodologies more focused and relevant to the needs of India. I am sure that this Field Day will provide you a good opportunity to continue doing so — for the benefit of pearl millet research at ICRISAT as well as in the interest of your own research programs. I hope that the materials that you will see and select will enhance your effectiveness in achieving your own research and development objectives.

I wish you all a comfortable and productive stay at ICRISAT and look forward to your input and partnership in shaping, sharpening and carrying out the pearl millet research agenda. Remember, the science we do should have meaning for the

rural poor in the SAT, and science and development should go hand in hand to win the war against hunger and poverty. We must win this war! Ladies and gentlemen, once again I welcome you all, wish you good luck, and look forward to the outcomes of these two days of a well-planned program.

Thank you!

Scaling-Out Fodder Technologies for the Benefit of Poor Livestock Farmers

Delivered on the Opening Program of the Workshop on Strategies for Targeting and Scaling-out Fodder Technologies for Small-scale Farmers in Developing Countries, 21 September 2004, ICRISAT, Patancheru, Andhra Pradesh, India

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I am happy that the CGIAR System-wide Livestock Program (SLP) is holding a very important workshop on "Strategies for Targeting and Scaling-out Fodder Technologies for Small-scale Farmers in Developing Countries" here at ICRISAT Center, Patancheru. The workshop is a follow up of the ongoing project on "Enhancing Livelihoods of Poor Livestock Keepers through Promotion of Food-feed and Forage Crops", in short the Fodder Innovation Project. The project, funded by DFID, is being implemented by ILRI in India and Nigeria in collaboration with ICRISAT, IITA, CIAT, IWMI, ICARDA, NARS, NGOs and the private sector.

The demand for livestock products is growing rapidly in most developing countries, but shortage of feed and fodder is a major constraint facing small-scale farmers in effectively meeting the demand. The scarcity is particularly acute in rainfed and dryland areas compared to better-endowed regions with better access to irrigation.

Collaborative studies between ICRISAT and ILRI in Asia have shown that the productivity of the livestock sector is closely associated with the availability of feed and fodder resources,

and that livestock are an important source of income for poor and smallholder farmers. These studies have further highlighted that a large number of improved technologies related to livestock nutrition have not reached the end users or their adoption levels were low due to poor targeting.

Under the Fodder Innovation Project, improved varieties of sorghum, pearl millet, groundnut, pigeonpea, cowpea, etc, developed by ICRISAT and IITA with its NARS partners and the private sector, are being vigorously promoted in farmers' fields. These varieties not only have a higher grain yield compared to traditional varieties but also contribute to higher straw yield and superior straw quality.

Under this project, improved varieties of forage crops like sorghum, sudan grass, hybrid napier, pearl millet, stylosanthes, bracaria, guinea grass, etc, developed by the national programs (ICAR institutions in India) and the private sector are being promoted in various locations with the help of NARS and local NGO partners. A unique feature of this project is the innovative institutional arrangements to promote the technologies rather than relying on traditional models of technology dissemination. Thus, training and capacity building, process documentation and dissemination pathways are important components of the project.

In India, the project has also joined hands with the ICRISAT–Andhra Pradesh Rural Livelihoods Project on upliftment of rural livelihoods through an integrated watershed approach. Since livestock and fodder are important to a majority of the rural poor, the close linkages between the two projects will lead to strengthening of livelihoods of the rural poor in a more holistic manner.

This workshop on upscaling/scaling-out of fodder technologies is timely and I am sure the review of case studies and lessons

"A unique feature of this project is the innovative institutional arrangements to promote the technologies rather than relying on traditional models of technology dissemination."

learnt in the dissemination of fodder technologies will provide answers on further scaling-out that would help in improving the welfare of poor and small-scale livestock farmers.

The SLP, and much more the Fodder Innovation Project, show the importance of inter-center collective action and strategic partnerships with various stakeholders for smallholder livestock farmers of the rainfed and dryland areas of the developing world. We need more of such partnerships to help improve the well-being of the rural poor.

Thank you.

Sorghum Becomes a Crop of Substance

Delivered at the Sorghum Scientists' Field Day, 22 September 2004, ICRISAT, Patancheru, Andhra Pradesh, India

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Good morning ladies and gentlemen!

It is my great pleasure to welcome you all on the occasion of this second Sorghum Scientists' Field Day in this millennium. The previous one was held in the year 2000 when I took the responsibility of leading ICRISAT. The main purpose of this Field Day is to provide an opportunity to all sorghum scientists – from the private and public sectors alike – to select and exchange breeding materials and to receive feedback on the breeding materials supplied earlier.

In many areas in the SAT, sorghum represents nearly the only crop option for small-scale farmers. Asia produced 20% of the world's sorghum in 2000-02. Within Asia, India with 7.4 million t and China with 2.9 million t dominate production, despite decreases in area (–2.9% and –5.6%, respectively).

The rainy-season sorghum area, especially in India, appears to have reached threshold level since it has to meet both food and fodder needs of livestock of smallholder farmers. Sorghum yields in Asia have increased, partially compensating for the

decline in area. This increase, though small, has been possible only because of your dedicated and focused research efforts. My congratulations to you all. Here are some of our achievements.

- The trait-based breeding approach at ICRISAT has utilized both racial and geographical diversity of germplasm to develop broadbased hybrid parents. These hybrid parents are used by both public and private sector scientists. I understand that more than 50 hybrids based on these hybrid parents and/or their derivatives are marketed in India, a factor that significantly contributed to cultivar diversity and stabilized production.
- Significant achievements have been made in the areas of identification of sources of resistance to insect pests and diseases, and gaining an understanding of mechanisms and inheritance of resistance. Sincere efforts have been made in transferring resistances into high-yielding background, particularly, cytoplasmic male sterile lines.
- A large volume of strategic research information was developed in the areas of improving screening methods and assessing virulence and severity of grain molds, the effect of alternate cytoplasms, methods of producing shoot fly-, stem borer- and midge-resistant hybrids, landrace pollinator-based approach to exploiting heterosis in postrainy season-sorghums, etc. Significant progress has been made in the identification of Quantitative Trait Loci (QTLs) conferring tolerance to shoot fly, stem borer and terminal drought stresses.

As the food use of sorghum is gradually declining in India, producers are often confronted with falling market demand. ICRISAT in partnership with various stakeholders took two major initiatives to broaden market demand.

"Besides developing sweet sorghum hybrid parents and varieties suitable for ethanol production in partnership with public and private sector scientists, ICRISAT facilitates private sector industries to incubate ethanol production technology from sweet sorghum."

Firstly, an ICRISAT-coordinated DFID-funded special project on "Exploring marketing opportunities for sorghum use in poultry feed" provided the scientific basis for complete replacement of maize with sorghum in poultry broiler feed formulations and helped to develop coalitions for marketing. Encouraged by the project's success, we submitted another project on "Enhanced utilization of sorghum and pearl millet grains in poultry to improve livelihoods of smallholder farmers", which has been endorsed by the FAO and in principle agreed to be funded by CFC.

Secondly, the Government of India's recent policy to blend petrol and diesel with 5% ethanol has triggered increased interest in the utilization of sweet sorghum as a potential alternative to sugarcane for ethanol production. Besides developing sweet sorghum hybrid parents and varieties suitable for ethanol production in partnership with public and private sector scientists, ICRISAT facilitates private sector industries to incubate ethanol production technology from sweet sorghum. For this, ICRISAT signed MoAs with Rusni Distilleries Pvt. Ltd., Andhra Pradesh, and Vasanthadada Sugar Institute (VSI), Maharashtra, for ethanol production technology utilizing sweet-stalk sorghum varieties.

The National Research Centre for Sorghum (NRCS) too is interacting with several distilleries for pilot and large-scale techno-economic feasibility studies to utilize sweet sorghum for ethanol production. I strongly believe that if we engage in partnerships with the national program, the synergies and complementarities generated by exploiting the capabilities of the national program and the diversified hybrid parent's development capabilities of ICRISAT could be capitalized for the national cause.

The expanded utilization transforms sorghum from a subsistence crop into what I would like to call "a crop of substance", making

our job more challenging than ever before. A lone institute cannot tackle all these challenges; partnership research is the way forward.

I am glad to know that in recent years, there has been an impressive growth and diversification in ICRISAT's research partnership with sorghum scientists in Indian programs under the umbrella of the ICAR-ICRISAT Partnership Research Project for the genetic enhancement of sorghum with special reference to basic and strategic research inputs for the ongoing national programs. Some of these are:

- The ICRISAT-Private Sector Hybrid Parents Research Consortium, which helps to produce diversified hybrid parents for use by both private and public sectors
- The Sehgal Family Foundation support for strengthening the sorghum program
- The ICBA-funded project on development of salinity-tolerant sorghum cultivars for enhanced productivity in saline lands
- The HarvestPlus program on identification of iron, zinc and b-carotene dense sorghums — a link project of ICAR-ICRISAT in partnership with the National Institute of Nutrition (NIN), Hyderabad
- Molecular markers for shoot fly and stem borer resistance and tolerance to terminal drought, supported by ADB/DFID/ ACIAR, being implemented by NRCS, and Parbhani and Dharwad Agricultural Universities
- The development of Bt gene transgenics resistance to stem borer in partnership with NRCS.

We have witnessed the power of conventional plant breeding in delivering goods. However, new science tools are increasingly becoming an integral part of the sorghum improvement program at ICRISAT, especially to improve difficult-to-breed traits.

Perhaps, this is the most appropriate forum to mention that ICRISAT management selected the proposal which summarizes the impacts of joint efforts of our partnership research globally – "Sorghum: a crop of substance" for submission to the CGIAR for the prestigious King Baudouin Award - 2004. Besides selecting the breeding materials in the field, I want you all to deliberate

today and tomorrow on the following issues and provide inputs based on your expertise and experience.

- What are the reasons for the limited success in breeding for resistance to shoot fly and grain mold?
- Are we providing sufficient incentives to scientists working on resistance breeding?
- What are the prospects for operationalizing molecular marker technology?
- Finally, should we at ICRISAT initiate new areas of research? If so, what are the areas which can be given up in lieu of the new ones?

I know that the time is short to deliberate on all these. However, I believe nothing is impossible, especially when experienced scientists such as you apply your minds together. I am confident that your expertise and experience will help ICRISAT be more focused and more relevant to national/ regional needs.

Finally, I wish you all a comfortable and productive stay at ICRISAT, and look forward to your inputs and partnership in shaping, sharpening and carrying out the sorghum research agenda. Let us carry out partnership research practicing *Science with a human face* to deliver products and impacts to benefit resource-poor farmers, consumers and sorghum-based entrepreneurs.

Ladies and gentlemen, once again I welcome you all and wish you good luck in all your endeavors to make sorghum the most competitive cereal crop.

Harnessing Gender Power in Integrated Watershed Management

Inaugural address, 27 September 2004, ICRISAT, Patancheru, Andhra Pradesh, India.

Ladies and gentlemen, good morning.

Let me extend to you a most warm welcome at ICRISAT. We have here today representatives from Vietnam, China and India. So are our partners like CRIDA, the Government of Andhra Pradesh, Agricultural universities, NGOs and most importantly, farmer representatives. Let me recognize the presence of Mrs Poonam Malakondaiah, Commissioner, Agriculture, Government of Andhra Pradesh, who has recently taken over the new responsibility and has found the time to visit ICRISAT and participate in this important workshop. I warmly welcome the Commissioner on this occasion.

We have a new partner in this workshop, the Tata Institute of Social Sciences through the collaborative project being supported by Sir Dorabji Tata Trust. As I understand, our trusted friend Mr Mukund Gorakshkar from Sir Dorabji Tata Trust could not make it for this workshop. Our USAID partners too could

not participate because of urgent commitments. Let me extend my invitation to all of you to enjoy our hospitality and beautiful campus.

ICRISAT's mission is to help millions of rural poor by adopting an integrated genetic and natural resource management approach and conducting research in partnership for greater impact on the livelihoods of millions of poor residing in dryland areas. We have adopted an integrated watershed management system, a flagship project, as a vehicle to reach large number of stakeholders and a gateway for our technologies to reach fields.

Although the watershed program is four decades old in India, and ICRISAT has been working for the past 30 years, the change in strategy during the last five years has shown remarkable benefits in order to achieve the goals of the integrated watershed management programs. The basic change ICRISAT and its NARS partners like CRIDA have introduced in the area of integrated watershed management, is building partnerships through a consortium. The partnership of research & development bodies, government institutions, civil society organizations with the farming communities has shown tangible impact in a number of dryland areas in India as well as in other countries such as China, Vietnam and Thailand.

The Adarsha Watershed (Kothapally) impact studies revealed that in addition to community benefits such as improved groundwater availability, reduced land degradation and increased productivity, there are equitable tangible economic benefits to small farm holders. The consortium approach

"A majority of our rural farming population are women. They need to be given the empowerment that will lead to harmony and prosperity in the rural areas."

adopted by ICRISAT and its partners is built on mutual trust amongst partners and the community in order to achieve sustainable development without damaging the environment. The new approach is holistic as against the compartmental approach adopted earlier. The emphasis on enhancing water use efficiency has resulted in doubling productivity and substantially increasing the incomes of farmers.

Integrated watershed management programs are now used as entry points for improving livelihoods, and in such a case, the large section of landless people as well as the weaker sections of society such as women and youth are also involved in the program through various micro-enterprises. As you know, development results in benefits, and associated costs should not be skewed towards a particular gender. However, the success of any development program and the need for sustainable development depend on the balance between inputs in terms of labor and resources and the benefits accruing to different sections of society.

The core agenda of the integrated watershed management program is to harmonize man's relationship with nature in order to manage natural resources sustainably. At a lower level, the program can be sustainable only if we can harmonize relations among different groups in the watershed as well as in the family that consists of different groups in terms of income, land holding as well as the gender perspective.

The theme on equity and gender need to be addressed through proactive means in order to scale up and institutionalize such perspective as a goal in the integrated watershed management program. This workshop's theme on harmony and prosperity to harness gender power in integrated watershed management is very timely and relevant.

A majority of our rural farming population are women. They need to be given the empowerment that will lead to harmony and prosperity in the rural areas. We all need to work together to achieve the central theme of the workshop. Let me clarify what we mean by gender in ICRISAT. It encompasses both men and women. Today, we have the bias of just empowering male

farmers and less of women farmers. They have to be both given the same opportunities to be empowered. Development efforts of institutions should therefore not just focus on one particular gender to enhance the sustainable development of rural areas.

Ladies and gentlemen, I am very happy that this initiative that has been put together by Dr SP Wani and his team to identify issues, deliver strategy and prepare pilot interventions, is very laudable. I am sure that your valuable inputs during the course of the workshop will greatly benefit all of us as well as others who are directly associated with the development of the rainfed/dryland areas of India.

I wish you success and fruitful deliberations during the workshop, and look forward to seeing the emerging recommendations and pilot initiatives. If we do this, then we will be doing *Science with a human face*.

Namaskar

Have a good day.

Transforming Grey Fields to Green Fields: Research Initiatives and their Impact in South Asia

Keynote address delivered at the Annual Symposium of the Department of Agriculture (ASDA 2004), 30 September –1 October 2004, Plant Genetic Resource Centre, Kandy, Sri Lanka

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Honorable Minister of Agriculture, Livestock, Lands and Irrigation, Mr Anura Kumara Dissanayake; Secretary, Ministry of Agriculture, Mr Tissa Warnasuriya; and Director General of Agriculture, Dr Sarath Weerasena, the Chair of ASDA 2004, Mr KE Karunatilake, distinguished guests, fellow scientists, ladies and gentlemen, good morning.

I am honored to be with you in your beautiful island country to attend this Annual Symposium of the Department of Agriculture. On behalf of ICRISAT and its stakeholders, I sincerely thank the Director General of Agriculture for inviting me to deliver the keynote address on this occasion. This gives me an excellent opportunity to share my views on combating poverty, hunger and malnutrition, especially in the semi-arid tropics of South Asia.

I. Introduction

It is most likely that a global movement for food production, popularly called the Green Revolution, saved the world from hunger. In my opinion, the Green Revolution missed a large section of poor people living in the marginal, and mostly rainfed areas. The high input-based Green Revolution technology was not for those who could not afford expensive fertilizer, water and insecticide. In such lands, amounting to about 700 million hectares worldwide, 800 million people are still waiting for another technological breakthrough to turn their grey fields into green.

ICRISAT has huge challenges and a global responsibility to improve the livelihoods of the poor of such environments, and we have taken up this challenge seriously in partnership with various stakeholders. Our goal is to harness the power of technology for development, food security, poverty alleviation and environmental protection, targeted at poor rural families in general, and women in particular. We call this *Science with a human face* — research not for its own sake, but targeted at specific goals and implemented through honest and active partnerships. Our science is planned and implemented accordingly. Our vision and strategy are built around water, energy, health, agriculture and biodiversity.

"Our goal is to harness the power of technology for development, food security, poverty alleviation and environmental protection, targeted at poor rural families in general, and women in particular."

Our specific research agenda revolves around four themes:

- Markets, policy and impacts
- Harnessing biotechnology for the poor
- Crop improvement, management and utilization for food security and health
- Agroecosystems development and management.

II. Harnessing biotechnology for the poor

Biotechnology-assisted germplasm enhancement activities at ICRISAT contribute to solutions for some of the complex problems that have remained intransigent to conventional methods. In the last two years, ICRISAT has initiated contained field trials of two transgenic crops. Early stage transgenics have been successfully developed for groundnut resistant to the Indian peanut clump virus, rosette virus and for pigeonpea resistance to the pod borer (*Helicoverpa armigera*).

III. Crop improvement for high and stable yields

It is a matter of great pride that in each of our mandate crops our scientists have made remarkable progress in many areas of diagnostic, strategic and applied problem solving research. The CGIAR's King Baudouin Awards to ICRISAT in 1996 for pearl millet, in 1998 for pigeonpea and in 2002 for chickpea are recognition of how effectively ICRISAT and its partners have together fulfilled their mission of delivering *Science with a human face.* For example, the traditional pigeonpeas are photo-sensitive, tall and mature in 6-10 months. These traits restrict its adaptation. So breeders developed a new plant ideotype which was less competitive, photo-insensitive, shorter and produced high yield. One such variety, ICPL 87, was released in India in 1986. This variety possessed not only the earlier-mentioned traits, but also escaped major biotic and abiotic stresses. This variety now covers over 200,000 ha in India.

Rescuing pigeonpea from disease

Fusarium wilt and sterility mosaic virus are the two most devastating pigeonpea diseases. The annual yield losses are estimated to be over US$50 m. ICRISAT has developed technology to breed highly-resistant cultivars such as Maruti

and Asha which have made tremendous impact in peninsular and southern India.

Rice-wheat system diversified with pigeonpea

In the 1960s, high-yielding cultivars of rice and wheat contributed greatly to increased food production in the Indo-Gangetic Plain of India; but in recent years cereal monocropping is showing signs of fatigue, leading to concerns about the sustainability of the rice-wheat system. Crop diversification was suggested as an answer and this provided ICRISAT with the opportunity to include legumes in the rice-wheat system.

A short-duration pigeonpea cultivar, ICPL 88039, developed at ICRISAT, was found most suitable. Testing began in 1996 and the area under ICPL 88039 is now expanding rapidly. This variety is remunerative for its grain, requires less water, produces much needed fuel wood and improves soil by adding organic matter to it.

Hybrid pigeonpea: A technological breakthrough

Pigeonpea is a favorite choice of dryland farmers because of its drought tolerance, low input requirement and ever-growing market with good prices. However, in spite of serious breeding efforts, average global pigeonpea productivity has remained unchanged at about 700 kg ha^{-1}, which is a matter of concern to all of us.

To achieve a breakthrough in the yield potential of the crop, a breeding technology to exploit hybrid vigor was developed at ICRISAT, the first for any legume crop. This resulted in the world's first commercial hybrid, ICPH 8, in 1991, which was released for cultivation in collaboration with the Indian Council of Agricultural Research (ICAR). This hybrid underwent rigorous field-testing and on average, recorded 25-30% more yield than popular cultivars and greater stability in farmers' fields across diverse environments. This hybrid breeding technology was shared with NARS in India and subsequently they also released five high-yielding pigeonpea hybrids.

To improve the hybrid seed production technology further, ICRISAT developed three efficient cytoplasmic male-sterility (CMS) systems after 10 years of hard work. This significant

development has brought the hybrid pigeonpea breeding technology at par with other cereal crops. Hybrid pigeonpea research is presently being supported by six Indian private seed companies. We hope the farmers will soon reap the benefits of this new technology.

The potential of pigeonpea demonstrated in Sri Lanka

Rural agriculture in the Dry Zone (4.17m ha) of Sri Lanka is centered around medium to large reservoirs that are used to irrigate rice, cultivated on the valley floors. The non-irrigable slopes and flat lands are invariably under *Chena* (shifting) cultivation. Legumes such as cowpea (22,000 ha), black gram (17,000 ha) and green gram (35,000 ha) are an integral part of rainfed upland agriculture. The average yield of these legumes is low (800 kg ha^{-1}) and the total national production (60,000 t) falls short of the annual requirements. To meet this deficit, each year large quantities of legumes are imported. Sri Lankan scientists saw that pigeonpea could fill the gap. With this in mind, successful attempts were made to demonstrate the production potential of pigeonpea in Sri Lanka under technical assistance from ICRISAT and financial support from the Asian Development Bank from 1990 to 1997. Today, ICPL 87 is an important cultivar in Sri Lanka.

Integrated Pest Management (IPM) in pigeonpea: Building upon indigenous knowledge

Pigeonpea pod borer *(Helicoverpa)* is an important production constraint. Crop losses due to it can range from 20-100% on farmers' fields, estimated to be more than US$310 m annually worldwide. To sustain the productivity of pigeonpea-based systems while preserving the environment, ICRISAT scientists have taken up multidisciplinary on-farm participatory Integrated Pest Management research in collaboration with NARS partners. This IPM approach currently concentrates on location-specific refinement of technologies in southern Asia.

Here is an interesting pigeonpea story from China. About 1,500 years ago some adventurous traders carried pigeonpea seed from India to China. However, it did not adapt well due to its long duration, small size, low yield and bitter taste. Yet the crop managed to survive in China for centuries because the local

people discovered the folk medicinal values of pigeonpea. In the 1950s, Chinese scientists started producing lac, a commercial resin, by rearing a beneficial insect, *Kerria lacca* Kerr, on pigeonpea. Eventually, the cultivation of pigeonpea in China ceased due to the loss of an international lac market.

Now, the newly developed ICRISAT pigeonpea varieties have high adaptability in the dry and degraded lands of southern China. Pigeonpea now occupies over 60,000 ha in this system.

Recently, the Government of the People's Republic of China honored ICRISAT pigeonpea breeder Dr KB Saxena with the country's highest civilian recognition called the 'Friendship Award' for his contribution to pigeonpea research in China.

Changing lives with chickpea

Chickpea, the world's third most important food legume, is currently grown on about 10.1 million ha worldwide. About 70% of this is South Asia's contribution. In Andhra Pradesh State of India, short-duration varieties such as the kabuli types Swetha and KAK 2, and the desi types Kranthi and JG 11, have shown a 5-fold increase in area and a 13-fold increase in production.

In Bangladesh, about 10,000 ha which usually remain fallow after rice cultivation, have been brought under short-duration varieties developed by ICRISAT.

In Myanmar too, short-duration chickpea varieties have been a boon to dryland farmers as they are more remunerative than wheat in short growing environments under rainfed conditions. During the last five years, chickpea area has doubled, production has trebled and yield has increased by 50%.

Chickpea occupies 80% of the pulse area in Pakistan. The most pressing biotic constraint is Ascochyta blight disease. ICRISAT has identified four distinct resistance sources, and developed four advanced breeding lines that reduced damage scores by about 50% in multilocational trials. ICRISAT also trained national scientists and helped establish a national chickpea breeding program in Pakistan.

Nepal's flatlands, the *Terai,* receives up to 1500-2500 mm of rainfall mainly used for rice cultivation. It remains fallow after

the harvest. ICRISAT, in partnership with the Nepal Agricultural Research Council, identified chickpea cultivars that could grow in these rice fallows. The adoption of chickpea was rapid, increasing from just 110 rice farmers in 1998-1999 to over 7000 farmers by 2001-2002.

Nutritive and income-generating groundnuts

South Asia accounts for 44% of the world's groundnut production. In the past three decades, the food and confectionery uses of groundnut have been increasing, and its use in oil and animal feed has been declining. With the exception of India, the research inputs in groundnut in other South Asian countries have been low. Therefore, scientists were heavily dependent on the introduction of germplasm from other countries/organizations. In this context, ICRISAT played an important role by supplying improved germplasm and elite groundnut varieties that have been released in Bangladesh (1), Myanmar (2), Nepal (1), Pakistan (2), Sri Lanka (3) and India (11).

Combating a new virus menace in groundnut

In the year 2000, a virus came to light in the district of Anantapur in India. This disease, called peanut stem necrosis disease (PSND), destroyed the crop in the district, leading to losses of over US$64 m in 2000 alone. ICRISAT and its NARS partners in India worked together to battle PSND. These efforts resulted in the identification of tobacco streak virus (TSV) as the causal agent, and how the virus is transmitted in the field. They also identified three cultivated varieties resistant to TSV.

Groundnut in Myanmar

Myanmar produces 413,000 t of edible oil a year, of which groundnut accounts for 40%. Mandalay, Magway and Sagaing are the major groundnut-producing divisions in the country. Four ICRISAT-bred groundnut varieties have been released in Myanmar.

IV. Integrated natural resource management in the drylands

In the absence of proper water and nutrient management strategies, the rainfed dryland farmers are unable to achieve

desired levels of food security. Current estimates indicate that substantial areas in Asia will be severely desertified if not properly managed, and that by 2020, many Asian countries might face serious food shortage. The International Water Management Institute (IWMI), Sri Lanka, has estimated that the Green Revolution areas in India are going through a depletion of water tables at the rate of up to 3 m per year due to the withdrawal of groundwater which is twice as fast as the natural recharging capacity.

ICRISAT and its partners have developed an innovative participatory consortium model for watershed management and established a number of benchmark watersheds in three countries. An Asian Development Bank study has indicated that investments made in rainfed areas are as remunerative as those made in well-endowed areas, but those made in the former have more impact on reducing poverty. This is the case with watershed development in China.

ICRISAT and its partners have made a beginning with watershed technologies by including livelihood enterprises; and they have also reaped a few successes.

V. Improving crop-livestock systems

Of all the farming systems in South Asia, the crop-livestock integrated systems are believed to have the highest potential for improving livelihoods in a sustainable manner.

Although ICRISAT is primarily a crops research institute, it now has a special interest in livestock because they are an important component of the farming systems where ICRISAT works. Since the mandate crops of ICRISAT, particularly sorghum, millet, groundnut and pigeonpea provide 10-15 t ha^{-1} of high quality dry fodder, their value for livestock is given special attention in our crop improvement program.

ICRISAT scientists together with the International Livestock Research Institute (ILRI) and national partners are now working on several projects related to stover quantity and quality of groundnut, sorghum, millet and pigeonpea. In China, pigeonpea has become an important feed source for livestock.

VI. A Virtual Academy for the Semi-Arid Tropics (VASAT)

Information and knowledge can play a pivotal role in drought mitigation and climate management. ICRISAT is leading a coalition called VASAT or the Virtual Academy for the Semi-Arid Tropics that is focused on sharing appropriate information and knowledge with farm communities and their intermediaries through the innovative interface of Information and Communication Technologies (ICT) and distance learning. Through VASAT, ICRISAT is fully committed to help India and other parts of Asia and sub-Saharan Africa mitigate the effects of drought.

Professor Uma Coomaraswamy, Vice-Chancellor of the Open University of Sri Lanka, participated in the establishment of VASAT and looked into the possibility of expanding the university's activities to cover tropical monsoon areas in South Asia.

VII. Public–private sector partnership: The way for the future

In agricultural research systems around the world, the roles of the public and private sectors, and the relationship between them, is changing because no single organization can address complex developmental issues.

Years ago, ICRISAT recognized that the private sector is a critical mechanism for delivering seed-based technology to poor people. We are fortunate to have commenced our relationship with the private sector in India in a small way. We have been able to build on that. Since 2000 we have had a growing number of privately funded research projects. This is a first for ICRISAT and is a novelty for the CGIAR as a whole. We hope to further expand collaboration on topics that are at the interface between public and private interests and expertise.

As of September 2004, a total of 25 private sector seed companies joined this consortium, generating for ICRISAT's research a total of US$400,000 in annual revenues over five years from membership contributions alone. ICRISAT has launched a number of initiatives to strengthen strategic alliances

with the private sector. Among these are the Biopesticide Consortium for Integrated Pest Management, Sweet Sorghum Consortium for Ethanol Production and the Agri-Business Incubator (ABI). All the private sector partnerships are now coordinated under a single institutional program called the Technology Innovation Center (TIC) and it remains a hallmark of our research progress at ICRISAT.

Agri-Business Incubator

ICRISAT's initiative in commissioning an Agri-Business Incubator is meant to help novel agri-business ideas bloom. The Incubator project was initiated with corpus funding from the Government of India coupled with our technologies and infrastructure. Rusni Distilleries Pvt Ltd, the first client for ABI, is collaborating to generate raw material to produce potable alcohol, and fuel alcohol from sweet sorghum varieties developed by ICRISAT. The ABI's second client, Bioseed Research India Pvt Ltd, is working on research projects related to the application of biotechnology for the development of superior cotton hybrids.

ICRISAT is providing technology assistance for using molecular markers, gene marker identification and genetic transformation. Some of the other technologies under consideration for incubation include generation of biodiesel from *Jatropha* and *Pongamia*, hybrid paddy and development of biopesticides.

VIII. Summary

Indeed, the Green Revolution of the 1960s/1970s was phenomenal, but people still go hungry because they are without a productive enterprise – and for a large proportion of the poorest, the main enterprise available is agriculture, whether as farmers, laborers, family members, village entrepreneurs, or others.

We are proud to have made significant contributions in this endeavor to ease their plight. The poor of the dry tropics are now learning to grow their way out of poverty, using appropriate technologies and knowledge.

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 the 'God given' limitations of land and capital.

We enthusiastically invite you to join hands with us in this noble Grey to Green Revolution. Let us keep in mind the recommendations of the Hunger Task Force of which I am a member, which leaders of this country and others can implement for a viable solution. I will enumerate them for you.

1. Move from political commitment to action.
2. Reform policy and create an enabling environment.
3. Increase agricultural productivity of food-insecure farmers.
4. Improve the nutrition of vulnerable groups that have chronic and hidden hunger.
5. Reduce the vulnerability of the acutely hungry through productive safety nets.
6. Make markets work for the poor and increase incomes of the food insecure.
7. Restore/conserve natural assets of the food insecure.

As you can see, it is not just leaders who can support these recommendations. You and I can together 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. By this we can face the challenge of halving poverty and hunger by the year 2015.

Ladies and gentlemen, before ending my presentation, I would like to thank you once again for your excellent hospitality and the opportunity given to me to interact with the Sri Lankan scientific community.

Thank you very much.

Linking National Professional Associations to International Research Organizations

Speech delivered at the 45th National Convention of the Philippine Agricultural Economics and Development Association (PAEDA), 12 October 2004, Bureau of Soils and Water Management, Quezon City, Philippines

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Introduction

Ladies and gentlemen, good evening.

I am indeed honored by your invitation to speak on this occasion and share some thoughts about harnessing effective linkages among national professional associations like PAEDA and international research organizations like ICRISAT.

I am also pleased to be your guest at PAEDA's 50th Anniversary celebrations with its compelling theme on "Accelerating Philippine Agricultural Sector: New Sources of Productivity Growth."

In speaking before you tonight, may I pose two questions:

1. How can we forge and strengthen strategic linkages in accelerating the growth of Philippine agriculture?
2. Through these linkages, how can national professional organizations like PAEDA position themselves as catalysts and strong advocates of policy reforms that will promote sustained agricultural growth?

The challenge

The Philippines has seen a mixed history of growth and development. Over the decades, our country has gone from being one of the richest in Asia after Japan to being one of the poorest. Over the last decades, a broad range of economic reforms and initiatives were designed to spur the country's business growth and foreign investment.

As a result, the Philippines saw a period of rapid and sustained growth in the last two decades. However, the Asian financial crisis in 1997 slowed down economic development.

Increasingly, the initial optimism about prospects for economic reform is being dimmed amidst concerns about graft and corruption. Likewise, perceptions of political instability dampen economic activity. The major bank failure in April 2000 and the untimely departure of the President of the Philippines in early 2001 also led to lower economic growth. Indeed, these challenges to the current administration, along with a slowing global economy have depressed prospects for our export-oriented Philippine economy.

As you all know, agriculture is still the driving force behind the Philippine economy. This sector contributes about one-fifth of the gross domestic product. One half of our GDP is from agriculture-based manufacturing and services.

Agriculture contributes about one-fourth of the country's export earnings and employs more than 40% of our labor force. In the past, agriculture enjoyed large trade balances. Unfortunately, it is now in deficit due to the declining competitiveness of the agriculture sector.

Thus, the major challenge facing our country today is how to arrest the declining competitiveness of agriculture compared to our neighbors in the region. Given this challenge, what role should PAEDA play, considering its vast potential in influencing policy formulation and agricultural transformation?

Role of PAEDA in accelerating Philippine agriculture

PAEDA was established to serve as a venue for free discussion of issues related to the development of the country's agriculture sector. This association has a mission of contributing to policy reforms to enhance agricultural productivity.

> "PAEDA must therefore mobilize national and international linkages and should actively work with government, the international community, media and other professional organizations to expand capacity in the pursuit of its noble mission."

PAEDA is indeed a key advocate of policy reform — a leading voice for agricultural economic development, where the building of consensus for policy reforms can be orchestrated. Thus, it is vital that PAEDA's playing field be elevated to achieve maximum synergy and sustainable results.

PAEDA must therefore mobilize national and international linkages and should actively work with government, the international community, media and other professional organizations to expand capacity in the pursuit of its noble mission.

Linking with IARCs and tapping innovations at ICRISAT

Building partnerships can significantly facilitate inter-disciplinary, inter-sectoral and inter-institutional synergies. Networking with countrymen and colleagues located in other countries is enriching, not only to build programs but also to cultivate opportunities and recognition among agricultural development professionals and students.

ICRISAT is one of the 15 CGIAR Centers worldwide. Our goal is to harness the power of technology for development, food security, poverty alleviation and environmental protection aimed at poor rural families in the semi-arid tropics (SAT) of Asia and sub-Saharan Africa.

We do *Science with a human face,* research not for its own sake, but tailored at specific goals and implemented through strategic partnerships. Our strategic approach is to match what ICRISAT has to offer with what its partners need. Through our stewardship, the organizational culture of ICRISAT has metamorphosed in recent years, with an innovative policy towards partnerships. During the last three decades, ICRISAT has been an effective bridge, broker and catalyst.

PAEDA can take advantage of this evolving innovation through partnerships. Promoting strategic national and international alliances among all other agricultural research and technology stakeholders can empower our present generation of agricultural economic development practitioners in effectively supporting policy formulation.

Agricultural economists can band in harmony with policy initiatives at the highest levels so that they can effectively articulate and prioritize their relevance and contribution. At the same time they can ensure ethical standards through professional associations and mentoring.

This generation of economic development experts can today evolve with holistic training, while based on a strong socio-economic mindset, sensitivity to the environment and its sustainability, information technology and entrepreneurship — all relevant to the needs of our society.

Building alliances and innovations

ICRISAT's strength originates from building alliances and innovations. At present, collaborations and partnerships exploit complementarities and comparative advantages and alliances are sought to address burning issues in research for agricultural development in the semi-arid tropics.

Collaboration is activated as strategic partnerships, networks, alliances with advanced laboratories and universities, and this is enhanced by establishing linkages globally through professional associations. It is through international collaborative partnerships that products of research are shared through capacity building, partnering and the use of information and communication technologies.

The challenges posed by food insecurity and poverty as well as by globalization and market liberalization for farmers in Asia and sub-Saharan Africa imply that new types of partnerships are required in agricultural research and development. International collaboration involves the active pursuit of a broad range of new and conventional arrangements to meet this challenge.

ICRISAT forges partnerships with various civil society and private sector organizations in addition to national agricultural research systems and advanced research institutes across Asia and sub-Saharan Africa .

This partnership ushered in the Grey to Green Revolution in the semi-arid tropics. Research partnerships for sorghum, pearl

millet, groundnut, chickpea and pigeonpea produced improved cultivars and their adoption generated higher yields, reduced unit production costs and led to greater farm incomes.

ICRISAT also leads the Cereals and Legumes Network in Asia, popularly known as CLAN. Composed of 14 countries around Asia, CLAN is a partnership model at work within the ICRISAT innovations framework. CLAN is now emulated in programs in Western, Southern and Eastern Africa.

Moreover, ICRISAT is recognized as a leader in promoting public-private research partnerships for pro-poor agricultural research, particularly on hybrid parents. Cutting-edge research and pilot studies on effective public-private partnerships are vital for pro-poor interventions in developing countries.

As part of a collaborative program of ICRISAT and its partners in India, village-level studies (VLS) are used for policy analysis and advocacy through improvements in the Social Science Information Repository database. The landmark database provides insights into the livelihood options and development pathways of the rural poor, feedback on technologies and serves as a socio-economic laboratory for teaching and training.

This is another area with good potential for collaboration among agricultural and development economists for policy reform and advocacy.

The CGIAR has also initiated Challenge Programs (CPs) that target the CGIAR goals in relation to complex issues of overwhelming global and/or regional significance. The CPs require partnerships among a wide range of institutions in order to deliver products. ICRISAT is actively involved in three Challenge Programs.

It may also be useful to know that the Institute has established student internships. These are offered to graduate and postgraduate students from partner institutions, including universities and institutes of management and technology. Interns work with ICRISAT scientists to gain international level research exposure and experience.

Virtual networks may also be tapped as avenues for open communication and wider synergies among geographically dispersed development practitioners. On our initiative on Information and Communication Technology – enabled technology exchange, we established the Virtual Academy for the Semi-Arid Tropics (VASAT) — a knowledge system to help vulnerable rural families cope better with the impact of drought.

VASAT was established by blending ICT with successful models of open and distance learning. Rural families living in the semi-arid tropics, which are vulnerable to drought, are VASAT's primary learners and stakeholders. The secondary learners are the policymakers, administrators and development agencies working on drought management. This is one model that PAEDA can consider while tapping into virtual networks.

Lessons in biotechnology emerging from the experience of the CGIAR Centers suggest that innovation requires a cultural change within research organizations. This new culture views science as a means to developmental objectives.

The Agri-Science Park (ASP) is a means by which ICRISAT moves commercialized technologies to help farmers in the SAT through partnerships with the private and public sectors.

Conclusion

In conclusion, ICRISAT's history has clearly demonstrated that centralized research output, no matter how valuable, will have a limited impact on agricultural production if the national systems do not have the capacity to be partners in the research and development of new and improved technologies for sustainable agriculture.

In defining a role for professional associations like PAEDA, we recognize the initiatives to improve the productivity and impact of agricultural research that should include research policy formulation, research planning and research organization and management.

This must be directed at improving the capacity not only for technology development but also for technology assessment

and sharing. These are important components of the development process that could promote the use of available technology, increase agricultural productivity and conserve the natural resource base.

Opportunities and challenges on evolving alliances and new types of relationships at the international level are open to PAEDA. The boundaries are increasingly expanding as we recognize the economic importance of knowledge creation and the need for greater collaboration among stakeholders involving science, business and society.

In this process, I assure you that linking with ICRISAT can be pivotal in forming dynamic partnerships, opening up channels of communication and fostering synergies.

As I close, let me mention the following recommendations of the Millennium Hunger Task Force, which, if implemented by the Philippine Government with the right investments, can help significantly reduce poverty, hunger and malnutrition in the country:

- Moving from political commitment to action
- Reform policies and create an enabling environment
- Increase the agricultural productivity of food-insecure farmers
- Improve nutrition of the chronically hungry and vulnerable
- Reduce vulnerability of the acutely hungry through productive safety nets
- Increase incomes and make markets work for the poor
- Restore and conserve the natural resources essential for food security.

Thank you and good night.

Filipinos: Respond, Reform, Renew!

Speech delivered at the University of Philippines Los Banõs alumni reunion, 16 October 2004, Las Vegas, USA

My friends and fellow alumni, good evening.

First of all, let me tell you how delighted I and my wife are to be here today, to be reunited with familiar faces and to get acquainted with new friends in this get-together.

It is a rare opportunity for me to meet a large number of friends and fellow Pinoys away from home. It has been providential that all factors crucial for this meeting have worked well to make it possible.

I would like to take this opportunity to convey my desire to promote awareness of our country's situation, and in doing this, aim to persuade you to lend a hand in bringing about the much needed transformation and renewal in our country.

It is unfortunate that our country has lost its position as one of the leading economies in Asia. One of the biggest challenges faced by our country today can be lumped into two Ds – *Debt and Deficit*. For every P100 in the national budget, P17 goes to paying our external debt. This is the highest debt service ratio among six Asian countries.

Over the last three decades, the quality of life of most of our countrymen has hardly improved. At present, there is widespread unemployment, prohibitive cost of living, mounting prices of basic commodities and skyrocketing fuel costs.

Only 79 out of every 100 Filipino children who go to school reach Grade 5. Our maternal mortality rate is the fifth highest in the region, while our food production per capita is the fifth lowest. Compounding these problems is our burgeoning population that is seriously affecting sustained economic growth.

But alleviating poverty is too daunting a task to be left to the government when it has become a part of the problem. Corruption has become endemic in our society, especially in the public sector. Our complicated and flawed tax laws further aggravate Philippines' problems.

The fiscal crisis in the Philippines today is so scary. Our country's public sector debt is already at 136% of its gross domestic product (GDP) and the ratio of revenues to GDP is 12%.

Without substantial reforms, the Bangko Sentral has said that the Philippine Peso will further weaken to the level of Pesos 57 to US$1.

Sadly, many of our countrymen have lapsed into resignation, apathy and indifference. Indeed, these problems facing our country seem impossible to solve. Only with determined and honest efforts by the government and the collective action of the people, good governance, modernized agricultural services, quality education, harnessing the Filipino's potential, moral recovery and transformation, can we overcome these hurdles.

The country must immediately move away from debates to decisive action. We must seek to reform and streamline government processes so that transparency and accountability will be promoted. Government must enhance the development of wealth creating opportunities, more so for the benefit of the poor people in the countryside. Apart from an honest and transparent government, our collective vigilance is extremely important to stop graft and corruption.

UPLB! Let me shift our attention to the agricultural sector, which is very dear to me because I am a son of a farming family in Ilocos. The agricultural sector accounts for 30% of the Philippine economy and directly supports 50% of the

"The country must immediately move away from debates to decisive action. We must seek to reform and streamline government processes so that transparency and accountability will be promoted."

workforce. Agriculture is a significant export winner and source of foreign exchange, and must therefore be given a central role in the blueprint for Philippines' progress.

In 1960, there were 27 million Filipinos to feed. Today, there are 82 million. Population increased by 180%, but farmlands lagged behind by only 24%. This puts tremendous production pressure on our farms and forces us to import to meet the ever growing demand for food.

To modernize Philippine agriculture, substantial investments must be made to build and rehabilitate irrigation, complemented by modern postharvest facilities. Improved technology must be practised by our farmers, guided by innovative extension communication. More importantly, the law needs to be reformed so that small plots and plantations co-exist and are made more productive.

Improved agriculture leads to higher rural incomes. This in turn will contribute to the national wealth and economic health of our country.

Another sector needed to propel progress in our country is education. We must ensure that every Filipino child has access to this very basic social service.

Despite our problems, we have a special resource to overcome them — our good people. Pinoys are counted among the best in the world. We provide the world with the most competent and qualified professionals: engineers, doctors, nurses, agriculturists and seafarers. This group of alumni is a good case in the US. Further, one out of every five seafarers around the world is a Filipino. Two out of every three foreign nurses in the UK are Filipinos. We have hundreds of thousands of engineers and workers in the Middle East. Overseas workers like you and me remit a big chunk of funds that help keep the economy afloat.

But being an overseas worker is not sufficient. We must also unite for a common cause and help national transformation and renewal by inculcating the values of discipline and hard work that we have acquired from our host countries.

Let us move forward by cultivating integrity and trust among our leaders. At this time, our country needs leaders with integrity. People with integrity lead with confidence; they walk with confidence and provide motivation to their people.

We may be living in a time of crisis, but we will overcome it by cultivating faith, hope and renewal among our people.

We are sons and daughters of the Philippines, who through determination and hard work, have been fortunate to lead a more comfortable life than others.

Let us therefore resolve to go that extra mile in helping our country. Let us renew our commitment to serve the common good. Let our service be clothed in love for our less fortunate countrymen. Wherever possible, let us provide jobs to the jobless and help promote agriculture, education, healthcare and tourism.

We must have that unwavering faith and hope that someday, we will overcome the difficulties in our country. In fact, let us all start today. Let our commitment to our country's improvement be firm and non-negotiable.

I wish you an enjoyable evening. Mabuhay po kayong lahat!

Challenges and Opportunities in Resource Generation at the Global Level

Speech delivered at the PCARRD Scholars Association, Inc. (PSAI) forum on Enhancing resource generation for agro- and forestry-based enterprise, 9 November 2004, Bureau of Soils and Water Management, Quezon City, Philippines

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Overview: The CGIAR

Colleagues in agricultural and natural resources research, good morning.

It is a pleasure being with you on this occasion to share our experiences at the CGIAR in mobilizing resources for agricultural science at the global level.

For more than 30 years, the CGIAR has been in the forefront of mobilizing science to serve the world's poor. Indeed, only a handful of organizations can claim that they truly have made a difference in the lives of the world's poor. Even fewer can lay claim to putting more and better food on the tables of billions.

The CGIAR is seen by many to be "one of the most successful ventures in the art and diplomacy of development assistance." As stated by the Chair of the CGIAR System Review, "investments in the CGIAR have been the best use of international official development assistance."

However, the context of international and national agricultural research systems has drastically changed since the 70s. Rapid globalization has redefined the way agricultural science and research are pursued and how organizations operate, communicate and eventually survive.

Moreover, the traditional relationship between North and South are being re-examined. A dynamic private sector is increasingly eclipsing the public sector whose resources are no longer adequate to set a development agenda for the new century.

Yet, there remains no greater imperative for collaboration between public and private sectors in agricultural research than the enormous challenge posed by global poverty and food insecurity. This imperative requires that limited resources be used more effectively to develop sustainable farming systems.

The real value of our day-to-day work at the CGIAR is often muted in the details of our science. On the other hand, the need for helping the rural poor shouts for world attention.

The impact of agricultural research usually gets noticed when dramatic scientific breakthroughs take place. For instance, the tremendous strides in yields and productivity achieved during the Green Revolution attracted wide global attention and acclaim.

Essentially, the CGIAR is a bridge, broker and catalyst for the exchange and development of cutting-edge science between the North and South.

CGIAR research does not provide an immediate 'bang for the buck.' It is not always easy to show its impact, and it does not have an easily recognizable brand name. In fact, the CGIAR and the nature of its work are not known in many parts of the world until recent public awareness efforts by the Centers began to change this.

"However, the real challenge is to reaffirm our relevance in today's society and to translate the meaning of our work and its impact to key stakeholders, especially the rural poor."

Changing context for agricultural research funding

Today, agricultural and natural resources research faces a landscape of stagnating Overseas Development Assistance (ODA), growing competition for resources, fast-changing technologies and increased expectations of measurable short-term impact and accountability by donors.

Donors, operating under their own political pressures, must assess their activities in the light of how they will benefit the average citizen at home. Traditional global institutions suffer from the perception that they are weak and outmoded and that they have lost their relevance in today's changing world.

Finally, we in the developing nations are asserting our right to be a full partner in the development agenda. Without our voices and the assurance that we are being heard, the credibility of any global development initiative is weak.

The challenge for us in agricultural research, in its most simplistic form, is to sustain our work by tapping into new or non-traditional sources of funding. However, the real challenge is to reaffirm our relevance in today's society and to translate the meaning of our work and its impact to key stakeholders, especially the rural poor.

In today's world, doing good is no longer enough for us. We must strive for scientific excellence and impact. The total global public and private investment in agricultural and food R&D is not enough to stave off the serious challenge of global food insecurity. We must find ways to impress this upon our donors so that we can continue to abide by our commitment to serve the rural poor.

Funding constraints to the CGIAR

In early 1999, The Conservation Company (TCC) was asked to explore potential approaches for the diversification and expansion of funding for the CGIAR. The urgency of this action was spurred by upcoming changes in leadership of the System and an acknowledgement of the static levels of ODA contributions to the CGIAR.

Supported by the Ford Foundation, the CGIAR and TCC embarked on a multifaceted investigation of all potential avenues

of CGIAR support. Despite obstacles including stagnant or declining ODA,nonawareness of the CGIAR name, low support for agricultural research and stiff competition for scarce funds, this exercise identified trends and new opportunities for funding international agricultural research. This is essentially the focus of my speech.

As part of the aforementioned exercise, interviews with private donors in Europe and the United States were conducted to assess the primary challenges of funding in the CGIAR. Let me share the major findings:

1. Perceived nonimportance of agricultural research: Agricultural research is not considered a priority by many private donors in Asia and Latin America, as the public sector has traditionally supported this field.
2. Low levels of awareness: The CGIAR is not well known outside.
3. Complex relationship with sustainable development: Environment and sustainable agriculture issues like natural resource management, biodiversity, water management, land use, technology exchange, economics and ethics are being linked to agricultural research.
4. Contextualizing research within socio-economic change: The CGIAR should link its research to poverty alleviation, hunger, food security and conflict resolution.
5. Fear of biotechnology: Consumer confidence in the safety and value of food and crops containing GMOs is low. This concern may spill over to the work of the CGIAR and impact on the willingness of donors to risk association with the System.
6. Cost of complexity: The differences in EU members' tax codes and the diversity of grant-making organizations make it difficult and resource intensive for the CGIAR to establish relationships at the national level.

Resource mobilization strategies of the CGIAR

The public sector

The public sector does not offer potential for great expansion but remains the major source of revenue for the CGIAR. Thus, it

offers the best potential for continued support for public goods research. The very size of public sector support for the CGIAR ($ 420 million in 2004), makes it unlikely that alternative sources of support will be available in the coming decade.

Thus, ODA is not replaceable by alternative sources of funding and is essential for the continuation of public goods research.

The CGIAR was asked to position itself to overcome the uncertainties of ODA support by developing and implementing innovative resource mobilization strategies. These strategies include communicating a clear and compelling case for the CGIAR's vision of achieving a food-secure world for all.

Our specific strategies for the public sector include:

1. Identifying priority areas in donor countries for ODA and non-ODA funding
2. Developing tailored advocacy programs at the national level
3. Mobilizing national science organizations where available and helping create them where they do not exist
4. Increasing Southern membership and participation
5. Documenting "flow-backs" to beneficiary countries
6. Considering incentive packages for membership
7. Expanding membership to regional and multilateral organizations
8. Analyzing alternative regional research funding mechanisms such as debt-swaps, fee-for service, contract research and other alternative models
9. Improving relationship with National Agricultural Research Systems (NARS).

The private sector

Private and corporate philanthropy offers good funding opportunities for the CGIAR. However, this resource is limited and will require a sustained and structured effort to promote initiatives consistent with the funder's priorities.

Nevertheless, if there is a clear convergence between the goals of a philanthropic institution and those of CGIAR Centers, we

see a potential for success. Foundations, however, are unlikely sources of sustained funding.

Our specific strategies for private and corporate philanthropy include:

1. Conducting targeted study tours for foundations to learn more about how the work of the Centers has a direct impact on their grantees and areas of interest.
2. Building awareness about the CGIAR through intermediary organizations such as the Council on Foundations, the Prince of Wales Business Leaders Forum and Asian Pacific Philanthropic Consortium.
3. Developing creative approaches to make research and related activities attractive to nontraditional donors.
4. Increasing opportunities for donor visibility in CGIAR initiatives like adopting proactive marketing tactics and involving the CGIAR alumni in communicating research results.

The new wealth

The new wealth presents a big opportunity of easy access to money. However, the competition for these funds is fierce.

This area may be high yielding, but it also requires big investment. A well-orchestrated plan to cultivate strong relationships with this wealthy entrepreneurial class will yield results like focusing on the converging biotech, pharmaceutical and hi-tech communities. For instance, the Bill Gates Foundation is now funding health-related research like vaccines.

Likewise, the merging of the hardware-software industry with biotechnology, called "bio-informatics", and the partnering of start-up companies is being funded by the same firms that bankrolled Apple, Intel, Microsoft and AOL.

Partnerships with the business community

Partnerships with the business community herald the future of public sector agricultural research. Private investment in agricultural research has overtaken public sector investment.

The CGIAR has natural affinities with many corporate communities engaged in agriculture and agriculture-related activities. Our challenge lies in finding ways to bridge the corporate culture with a culture of public good and poverty alleviation.

Social marketing is our first step in developing these new partnerships. Joint ventures that commercialize Center research and other products are also being explored. Several centers are considering piloting a number of social marketing ventures.

In addition, centers like ICRISAT have already developed valuable partnerships with agri-business companies. For instance, we have established an Agri-Science Park (ASP @ ICRISAT) as the vehicle for commercializing our technology to help poor farmers in the semi-arid tropics. This is carried out through partnerships between the Technology Innovation Center (TIC), private and public sectors.

The Agri-Science Park consists of an Agri-Biotech Park, Agri-Business Incubator, Hybrids Parents Research Consortium and the SAT Eco-Venture. We are also collaborating with Sun Microsystems in developing an e-learning platform for our Virtual Academy for the Semi-Arid Tropics (VASAT).

Public and private financing mechanisms

The CGIAR is being asked to experiment with creative public and private funding arrangements for agricultural research including loans and credit to finance contributions, endowments, e-commerce and others.

Creating an endowment is one of the leading mechanisms for long-term sustainability of key components of the system. It is the very challenging as it requires strong leadership, a well-focused campaign and a winning message.

Experts in this field point to the potential yield, but stress the need for careful planning and preparation, which requires considerable time and investment. Along with this, ICRISAT has created an endowment fund worth $ 4 million with the Suri Sehgal Family Foundation in India.

Conclusion

In spite of stagnating ODA support, opportunities for funding international and national agricultural research especially from nontraditional sources exist. We must therefore harness them. Although this will not result in an immediate influx of new funds, I am confident that they will yield significant results over time.

From our end, we must do serious soul searching and re-chart the vision of agricultural research in the Philippines in this century. Our success in mobilizing new resources depends on our ability to project competence, success and a serious commitment to serve the rural poor.

As I close, let me suggest 10 immediate steps to move forward:

1. Immediately increase institutional capacities for resource mobilization by sharpening the competencies of core staff and researchers on project development and marketing. ICRISAT can help you conduct regional workshops on resource mobilization and project development.
2. Map out, invest on and implement an integrated communication and resource mobilization plan for the Philippine NARES. We can hold a joint workshop among DA-OSEC, BAR, PCARRD and ATI towards this.
3. Prepare a comprehensive business plan to fund the integrated communication and resource mobilization plan.
4. Develop consensus among key stakeholders to gain their support in implementing integrated communication and resource mobilization initiatives.
5. Seek the help of local and international experts with fundraising and communication skills to implement the plan.
6. Harness senior scientists and influential allies in Congress, the Executive Branch and LGUs to help promote our work towards resource mobilization.
7. Identify and implement bankable, impact-oriented and high-profile activities that could attract new funding.

8. Showcase promising, high priority alternative financing arrangements (like tie-ups with the private sector) to gain experience and test their feasibility for wider application.
9. Focus your research work to help improve food security, alleviate hunger, conserve the natural resource base and promote rural development, especially in the uplands.
10. Communicate your work and effectively share success stories with traditional and new donors who will ultimately provide a more diverse and sustainable funding base.

In all your resource mobilization endeavors, ICRISAT will be there with a helping hand.

By working together, we will surely succeed!

Salamat at mabuhay kayong lahat!

Resource Conservation and Agricultural Productivity*

Inaugural address delivered for the National symposium on Resource conservation and agricultural productivity, 22-25 November 2004, Punjab Agricultural University, Ludhiana, Punjab, India

The Earth does not belong to us
We belong to the Earth.
For we do not weave the web of life;
We are merely strands within it.
Whatever we do to the web,
We do it to ourselves

[Chief Seattle, 1835]

Two hundred years ago, citing the limits on the extent and quality of agricultural land and concerns about population dating back to Plato and Aristotle, Thomas Malthus argued that population growth would inevitably outpace food production — unless checked by "moral restraint, vice (or) misery" (Malthus 1982).

By 1960, Malthus' concerns appeared well founded. Growing at an unprecedented rate, the world's population reached 3 billion, of which about a third were chronically undernourished. Four decades later, the world's population has doubled to 6 billion and demand for food has grown with it. However, food production has grown even faster, and the number of people who are chronically under-nourished has fallen (Fig. 1).

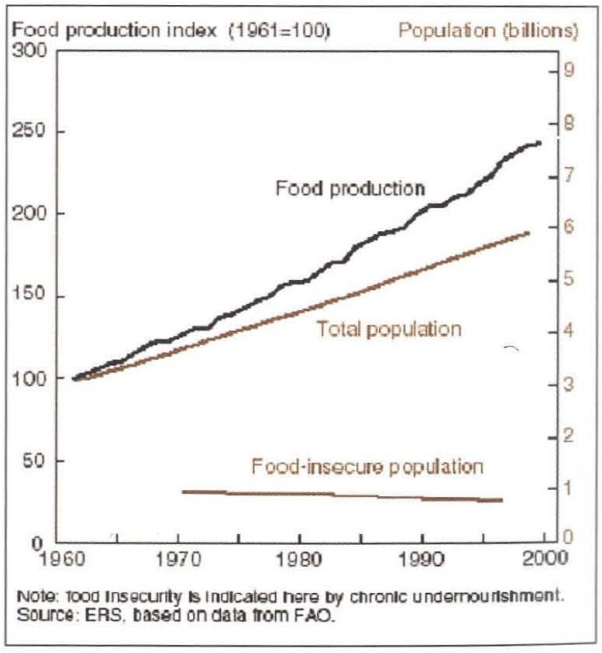

Figure 1. World food production and population, 1960-2000.

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* The speech was distributed at the venue.

Despite these achievements, more than 800 million people remain chronically undernourished, most of who live in Asia or Africa. For many of these people, food security depends on income from agriculture, and thus on the quality and productivity of natural resources.

One of the very important natural resources, ie, cultivable land, is becoming unproductive because of increased degradation. In India alone, about 8.4 m ha in arid, 52.6 m ha in semi-arid and 43.6 m ha in sub-humid regions are prone to desertification (Table 1.) Apart from increased desertification, the population of developing countries too is on the rise. It has been estimated that by 2050, India and China will be adding about 519 and 211 million, respectively to their already existing populations (United Nations 2001). Depletion of natural resources, increased desertification and increases in population have raised doubts about the sustainability of agricultural production.

Table 1. Extent (million ha) of desertification in south and southeastern Asia[1].

Country	Arid	Semi-arid	Dry sub-humid	Total	Susceptible dryland area (%)
India	8.4	52.6	43.6	108.6	57.5
Pakistan	52.5	8.9	1.1	62.4	85.7
Nepal	0.0	0.0	0.5	0.5	32.4
Thailand	0.0	0.0	4.2	4.2	100.0
Sri Lanka	0.0	0.3	1.4	1.7	100.0
Myanmar	0.0	0.0	0.2	0.2	9.9
Total	60.9	61.8	51.0	177.6	

Source: World Atlas of Desertification, Second Edition (1997 UNEP).

1. These figures do not include natural rangeland and forest areas, which are also affected by desertification.

"Sustainability is thus a dynamic concept that reflects changing levels of output corresponding to changing human needs and production technologies over time."

Sustainable resource use is central to food security, which involves the ability to meet both food and non-food requirements to sustain human and other resources over time. Sustainable resource use and food security together depend on ways in which resources are used in production and exchange, in the generation of income and in subsequent patterns of consumption and investment.

Food security is generally defined in terms of access by all people at all times to sufficient food for an active and healthy life (World Bank 1986). Two features of this definition are particularly important in the present context. First, access must be sufficient for activity and health. Second, access must be sufficient at all times: in the long term and thus closely related to sustainable resource use and under all possible circumstances within any particular period of time, raising the notion of vulnerability.

It was estimated that the share of people who do not have access to sufficient food in 67 developing countries would decline from 34% in 1999 to 32% in 2009 (Shapouri and Rosen 2002). The gap between the amount of food available in these countries and the amount needed to meet various consumption standards is largest in sub-Saharan Africa, where population growth is relatively rapid, commercial imports are limited by financial constraints and production is constrained by low levels of technology and poorly functioning markets.

Resource conservation and agricultural productivity

The natural resources of a country are its most valued endowment, on which all life depends. Their prudent management will enable sustainable development without loss of the resource base. Thus sustainability implies not only conserving natural resource products, but also maintaining the supply of natural resource products that are essential to the livelihoods of local people. Sustainability is thus a dynamic concept that reflects changing levels of output corresponding to changing human needs and production technologies over time.

Land is one of the most basic resources used in agricultural production. Evidence suggests that only when land-related

constraints have been overcome do factors such as labor quality, road density and mechanization become significantly associated with improvements in agricultural productivity.

Land-related constraints can be intrinsic or induced. However, both result in a decline in the biological activity of the soil in most agricultural systems. This threat can be addressed by mobilizing and integrating knowledge on scientific land use planning that utilizes digital information technology and a shift in research imperatives to future oriented issues such as the identification of indices of sustainable land management and the long term on-site and off-site consequences of agricultural practices. Such activity should involve communities and farmers so that the new practices are owned and followed by all.

Coming to water, the main driver for the Millennium Development Goals (MDGs), it is estimated that by 2015, one third of the world's population,. mostly in the developing countries, will be facing water scarcity. The target of halving the number of people without access to safe drinking water and halving the proportion of people who are hungry will require improved water management (Figure 2). The 2002 World Summit on Sustainable Development (WSSD) included agriculture in its WEHAB (Water supply and sanitation, energy, health, agriculture and biodiversity) framework to tackle the world's most pressing development challenges. The Summit approved a supplementary target of halving the proportion of people without access to sanitation facilities. According to the latest FAO report titled "The State of Food Insecurity in the World 2003", the latest estimates show that the number of hungry people

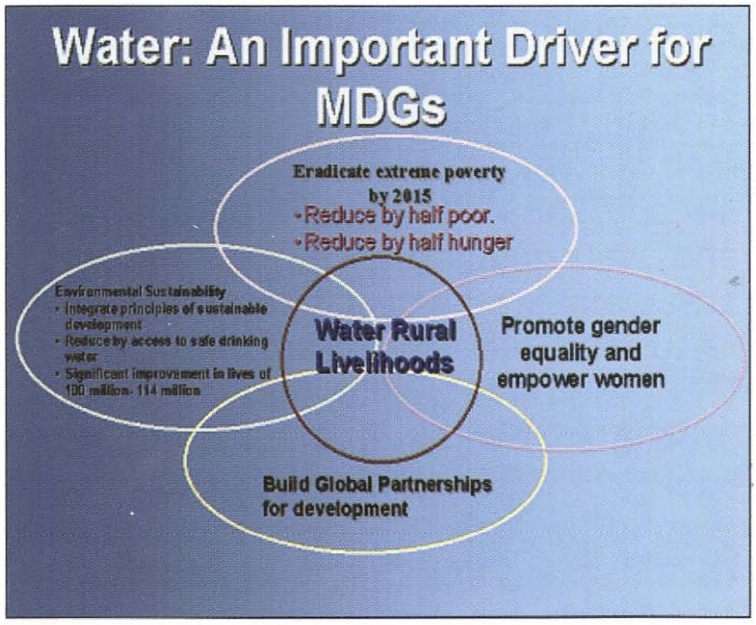

Figure 2. Linkages between water and the Millennium Development Goals.

around the world increased by 18 million to 842 million (of which 798 million are in developing countries) by 1999-2001 (FAO 2003).

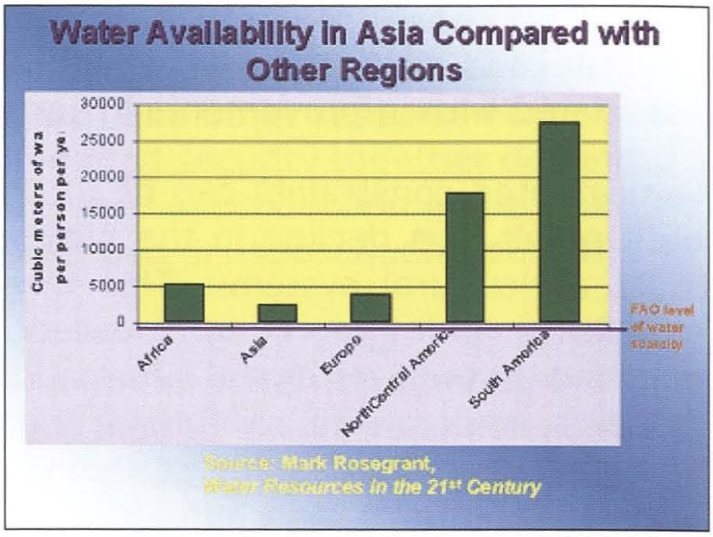

Figure 3. Regionwise availability of water in the world.

Water availability in Asia is the lowest (2500 cubic meters per head per annum) in the world (Fig. 3). The future challenge at the global and regional levels is to achieve water security that is directly related with the food and health security of mankind. The second World Water Forum was a landmark event in the evolution of global water consciousness. It is therefore imperative for everybody to take on the responsibility of realizing a safe water world.

The challenge

India faces a far greater challenge. It houses 16% of the world's population, 4% of its water resources and 2% of its land. In India, 83% of the water is used for agriculture, 5% for municipalities, 4% for industry and 8% by others.

Though the Green Revolution led to a national surplus for major food staples, gains in food production in the irrigated areas are already showing signs of yield fatigue. In addition, salinization and waterlogging have made incursions into canal irrigated areas and water deficit regions such as Rajasthan, resulting in unsustainable crop production. Depleted groundwater levels and dried borewells and open wells pose another set of problems. Even water sufficient areas such as the Godavari basin in Andhra Pradesh suffer from overexploitation of groundwater. In the coastal areas, farmers are complaining of the intrusion of seawater into their borewells.

India faces the major challenge of feeding its growing population and catering to water demands from competing

sectors. This calls for an Integrated Water Resource Management Approach (IWMA). We need a changed paradigm for IWMA with emphasis on water demand management in addition to increasing efforts to augment water supplies for all uses. Merely increasing its supply cannot solve our problems.

Genetic resources

While on the one hand human capacity to produce novel genetic combinations through recombinant DNA technology is increasing, the rate of loss of genes, species and habitats, rich in biodiversity, is also keeping pace (Global Biodiversity Assessment 1995). The Convention on Biological Diversity (CBD) adopted at the UN Conference on Environment and Development (UNCED) at Rio de Janeiro in June 1992 is a clear index of the international community's concern for and commitment to conserving and utilizing biodiversity.

The future of global food security depends on the success of our efforts in conserving and enhancing agrobiodiversity. The technical conference convened by the FAO in Leipzig, Germany, in June 1996, to consider issues relating to the conservation of genetic resources has urged all nations to implement a global plan of action for the conservation and sustainable utilization of plant genetic resources for food and agriculture (FAO 1996). Genetic engineering offers new opportunities for the development of effective Integrated Pest Management (IPM) and Integrated Nutrient Supply (INS) systems. However, the loss of every gene and species will limit our options for genetic recombination in the future.

Converting challenges into opportunities

The Green Revolution delivered benefits mainly to more favorable agro-ecological zones having ample water and capital resources. It bypassed dryland cropping areas. Despite the Green Revolution, there are still about 840 million people, or 13% of the global population, who are food insecure, mostly living in the dry areas of the semi-arid tropics (Dar 2001). Therefore, the challenge now lies in moving the Green Revolution into ecologies, systems and populations that have not benefited significantly from technological advances.

Here I would like to illustrate to you what we at ICRISAT are doing for the efficient management of natural resources. ICRISAT, in collaboration with the Government of Andhra Pradesh and various Indian organizations, NGOs and development agencies, has adopted a Participatory consortium approach to natural resource management for watersheds at Kothapally in Ranga Reddy district of Andhra Pradesh. The model's main components (Wani et al. 2002) are:

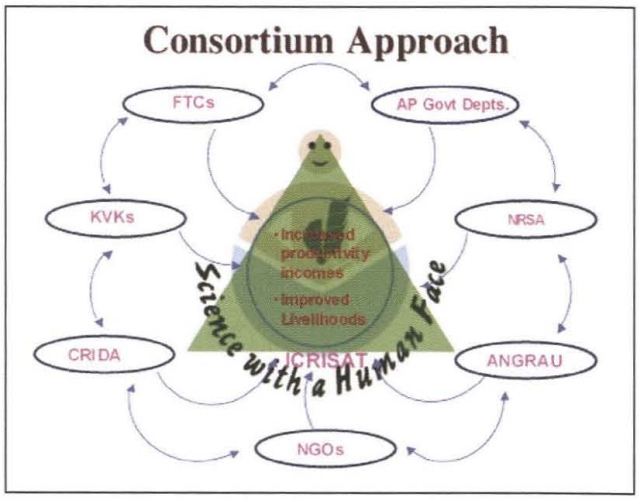

Figure 4. ICRISAT's innovative Consortium approach to watershed management.

- Collective identification and prioritization of problems for possible intervention by farmers
- Participatory planning and implementation
- Use of new science and technology
- A holistic approach to livelihood improvement
- Adoption of consortium approach to provide technical backstopping (Fig. 4)
- Scaling-up and technology dissemination using benchmark sites as training sites
- Cost-effective and environmentally-friendly soil, water, nutrient, crop and pest management practices
- Blending traditional and new approaches
- Empowerment of communities, individuals, NGOs and the strengthening of village institutions for effective technology dissemination
- Initiation of income-generating micro-enterprises involving youth, women and the landless
- Continuous monitoring and participatory evaluation by researchers and stakeholders.

The emphasis of our consortium model is on increasing agricultural productivity and incomes of rural people through efficient and sustainable use of natural resources in the watershed.

Convergence of activities in the watersheds helped achieve these goals (Fig. 5).

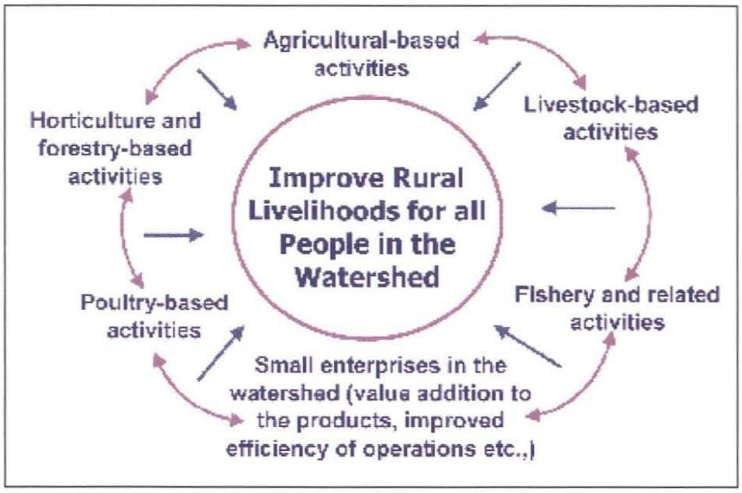

Figure 5. Convergence of activities in the watershed.

An assessment of the impact of integrated watershed management interventions on poverty and livelihoods of the rural communities clearly showed that average net returns per hectare for dryland cereals and pulses were 1.5 - 2 times higher within the watershed.

Based on the success of this model at Kothapally, the Andhra Pradesh Rural Livelihoods Program (APRLP), Sir Dorabji Tata Trust and the Asian Development Bank (ADB) have selected this model to scale up the benefits in Andhra Pradesh, Gujarat, Madhya Pradesh and Rajasthan in India, and northeastern Thailand, northern Vietnam and South China.

Conclusions

Severe land degradation, depletion of natural resources and enhanced population pressure are posing serious threats to humanity. Hence, we need to develop strategies to improve agricultural productivity that take into account the potentialities and limitations of natural resources, climate, soils, water and vegetation for their sustainable use. Integrated genetic and natural resource management (IGNRM) potentially addresses the use of environment degradation, while enhancing production.

It must be remembered that a "sustainable economy" is the product of sustainable development. However, when people define an activity as sustainable, it is on the basis of what they know at that time. There is no long-term guarantee of sustainability, because there are many unknown or unpredictable factors.

Lastly, I would like to say that there is a lesson for all of us here: be conservative in actions that could affect natural resources and the environment, study the effect of such actions carefully, and quickly learn from mistakes.

References

Dar WD. 2001. Achieving a grey to green revolution in India. Pages 169-184 *in* Bringing science with a human face to the Semi-Arid Tropics: A compendium of speeches and presentations by William D Dar. Patancheru, Andhra Pradesh 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. 192 pp.

FAO. 1996. Report of the International Technical Conference on Plant Genetic Resources. Leipzig, Germany.

FAO. 2003. Water and food security. *In* The state of food insecurity in the world - 2003. Food and Agriculture Organization, United Nations, Rome, Italy. 40 pp.

Global Biodiversity Assessment. 1995. United Nations Environment Programme (V. H Heywood, ed.). Cambridge University Press: UK. 1140 pp.

Malthus TR. 1982. An essay on the principle of population. London: J.M. Dent & Sons Ltd. (Reprinted from the seventh edition of 1872; first edition published in 1798.)

Rosegrant, Mark W, Ximing Cai and **Sarah A Cline.** 2002. World water and food to 2025: Dealing with scarcity. Washington, DC: International Food Policy Research Institute.

Shapouri, Shahla and **Stacey Rosen**. 2002. Food Security Assessment. International Agriculture and Trade Report GFA-13, Washington, DC: Economic Research Service, U.S. Department of Agriculture.

United Nations. 2001. World population prospects: The 2000 revision (Volume 1): Comprehensive tables. New York: Department of Economic and Social Affairs, Population Division.

Wani SP, Pathak P, Tan HM, Ramakrisha A, Singh P and **Sreedevi TK** 2002 Integrated watershed management for minimizing land degradation and sustaining productivity in Asia. Pages 207-230 *in* Integrated land management in dry areas: Proceedings of a Joint UNU-CAS International Workshop, 8-13 September 2001, Beijing, China (Zafar Adeel, ed). Tokyo, Japan: United Nations University.

World Bank. 1986. Poverty and hunger: Issues and options for food security in developing countries. Washington, DC: The World Bank.

The Renaissance of ICRISAT

Speech delivered on ICRISAT Loyalty Day, 14 December 2004, ICRISAT, Patancheru, Andhra Pradesh, India.

My most esteemed colleagues, good afternoon.

We are gathered here today to honor our staff who have given their best years to ICRISAT. Every year, we pay homage to our colleagues who, like everyone of us, worked so hard to produce and mobilize the best science in winning the battle against hunger, poverty, malnutrition and environmental degradation.

Many of you seated here today may have been with ICRISAT ahead of me. You rode the wave of success in the eighties as well as survived the challenging times in the nineties. Through these times, loyalty, faith and dedication have sustained your relationship with ICRISAT.

A common thread indeed binds all of you who have received awards today. You have loyalty to ICRISAT, faith in its vision

and mission, and dedication to its overall aim of improving the lives of the poor people of the semi-arid tropics. You believe that ICRISAT symbolizes excellence, innovation and success.

As awardees, I am proud to dedicate this day to all of you.

Today, I am delighted to announce that ICRISAT stands tall within the CGIAR. For the fourth time, we won the King Baudouin Award during the CGIAR Annual General Meeting in Mexico. We shared this award with CIMMYT, IRRI, IWMI and other national systems in the Rice-Wheat Consortium for the Indo-Gangetic Plains. With our fourth King Baudouin Award, ICRISAT is now unequalled in the CGIAR.

Also for the fourth time, ICRISAT bagged the CGIAR Young Scientist Award with Lava Kumar winning it back-to-back with Jonathan Crouch last year.

I am also proud to announce that ICRISAT has finally achieved financial stability. Early this year, ICRISAT was rated as "superior" by the World Bank based on its scientific and financial performance.

Likewise, ICRISAT is practically on top of the CG System. Our Board Chair, Professor Uzo Mokwunye is Chair of the Committee of Board Chairs (CBC). On the other hand, I am the incoming Chair of the Center Director's Committee (CDC) and Dyno Keatinge is incoming Chair of the Center Deputy Directors Committee (CDDC).

I would like to emphasize that these accomplishments are the result of our collective efforts through TEAM ICRISAT. Notwithstanding these, however, I am a firm believer in the dictum that 'when one is on top, it is time to improve.'

"A common thread indeed binds all of you who have received awards today. You have loyalty to ICRISAT, faith in its vision and mission, and dedication to its overall aim of improving the lives of the poor people of the semi-arid tropics."

Hence, even as we are on top, we still need to run the extra mile, transcending our comfort zones. We need to do this because of the enormous complexities and new challenges in our task environment.

As we face these challenges, we must further enhance the culture of working together within and outside ICRISAT. We must further enhance the culture of innovation to be ever relevant, winning the hearts, soul and minds of the people we serve, thereby reaping more successes and impacts in the semi-arid tropics of the developing world.

For us to reap more successes, let me exhort all of you to further continue the process of *renaissance* or *rebirth* that we have started under my stewardship of ICRISAT.

This morning, we presented to you our new vision and strategy to 2010. The new vision and strategy is our major instrument for institutional *renaissance* or *rebirth*. Henceforth, I expect every member of TEAM ICRISAT to internalize, support and implement our new vision and strategy.

Even as we are clear of what is ahead of us, let us bring out and pursue more changes and innovations for the Institute. Let us further bring out the best within ICRISAT. Along this, we will further strengthen our organizational structure. Beginning next year, we will implement a more decentralized organization and management set up.

Our Regional Representatives in sub-Saharan Africa will be elevated as Regional Directors, armed with more technical and administrative powers. The Management Group too will be strengthened with the elevation of the Heads of Project Development and Marketing and Communication as Directors.

Today, ICRISAT and the whole CGIAR operate under a new context or a new environment. During the recent Annual General Meeting, the CGIAR was urged to focus on what it does best — providing global public goods and helping national systems build capacity to fully take up their own responsibilities.

Moreover, we are being asked to link our research agenda to the Millennium Development Goals (MDGs) in order to increase focus on interdisciplinary and real development issues. Relevant issues will also be linked with our programs like sustainable development, health, HIV/AIDS, post-conflict rehabilitation, gender, biodiversity, water management, high-value crops and resource conservation. The revolutions taking place in biotechnology and information and communication technology offer tremendous opportunities to empower the poor of the semi-arid tropics.

But the poor cannot be empowered without the loyalty and dedication of TEAM ICRISAT. Along with our rebirth, let us therefore rededicate ourselves to the cause of the rural poor by doing *Science with a human face*.

Thank you and good day.

Reaping the Seeds of Success

Speech delivered during the 32nd Annual Day celebrations, 15 December 2004, ICRISAT, Patancheru, Andhra Pradesh, India

His Excellency, Mr Yasukuni Enoki, Mr Barwale, Dr Ta Minh Son, Dr and Mrs Charles Renard, guests and my dear colleagues at ICRISAT, good afternoon.

It gives me great pleasure to speak before you on this momentous event at ICRISAT. Today, we are honored to have with us His Excellency, the Ambassador of Japan, Mr Yasukuni Enoki. Our ties with the Government of Japan date back to 30 years. During this period, Japan and ICRISAT have been working together to help improve agriculture in sub-Saharan Africa and Asia.

As we celebrate our Annual Day, I am honored to announce that we have come out as winners, reaping the seeds of success we have sown in the semi-arid tropics. For the fourth time, we won the King Baudouin Award during the CGIAR Annual General Meeting in Mexico. We shared this award with CIMMYT, IRRI, IWMI and other national systems in the Rice-Wheat Consortium for the Indo-Gangetic Plains. With our fourth King Baudouin Award, ICRISAT is now unequalled in the CGIAR System.

Likewise, for the fourth time, ICRISAT bagged the CGIAR Young Scientist Award with Lava Kumar winning it.

In a very rare circumstance, ICRISAT is practically on top of the CG System, and much more in the Future Harvest Alliance. Professor Uzo Mokwunye is Chair of the Committee of Board Chairs (CBC), I am the incoming Chair of the Center Director's Committee (CDC), now the Alliance Executive and Dyno Keatinge is incoming Chair of the Center Deputy Directors Committee (CDDC).

After years of turbulence, I am proud to announce that ICRISAT has finally achieved financial stability. Last year, we had a surplus of US$ 0.550 million. Early this year, ICRISAT was rated as "superior" by the World Bank, based on its scientific and financial performance. Furthermore, special project funding rose from US$6 million in 2000 to US$11 million last year. It is expected to surpass US$13 million this year.

Even with this turnaround, we continue to aggressively pursue cost management initiatives in travel and procurement. We are also obtaining better rates and competitive supplies. This year, we have brought down our energy cost by 20%. Similarly, we have reduced fixed costs down to 30% by reviewing our communication infrastructure and surrendering surplus capacity.

We have also identified alternate technologies in these areas, which when fully implemented, will lead to an additional 20% cost saving next year.

Our collective efforts in resource mobilization are bearing fruit. This year, we have received pledges worth US$15.4 million for 73 projects out of 114 proposals. At present, nearly 55% of ICRISAT's annual budget of US$26 million comes from special projects.

"Early this year, ICRISAT was rated as "superior" by the World Bank, based on its scientific and financial performance."

As part of our win-win strategy for sub-Saharan Africa and Asia, we are fortifying our management and administrative set up by strengthening decentralization. Effective next year, our Regional Representatives in sub-Saharan Africa will be elevated as regional Directors. The regional Directors will have more technical and administrative powers. The Management Group will also be strengthened with the elevation of the Heads of Project Development and Marketing and Communication as Directors.

At this juncture, let me report our breakthroughs in research, the core business of ICRISAT. The results of our work in genetic transformation are very promising. The world's first transgenic groundnut is in its third year of contained field trial at ICRISAT. Also, the world's first transgenic pigeonpea is now in its second year of trials.

We are evaluating 51 independently transformed lines of chickpea carrying the P5CSF129A gene in T3 generation for drought tolerance in chickpea. The parental lines of popular millet hybrid HHB67 have been improved for downy mildew resistance through marker-assisted backcrossing and improved lines for release in early 2005 by the public sector.

Our impact studies show interesting opportunities for women in the semi-arid tropics. Our social analysis on adoption mediated by gender and social capital have given us useful insights into the substantial differences in men's and women's networks, household food security, drudgery reduction and employment opportunities.

In sub-Saharan Africa, ICRISAT is promoting systems diversification in the Sahel through the African Market Garden, Sahelian Ecofarm and Desert Margins Program. The market-led initiatives in Eastern and Southern Africa are also making big strides. In Kenya, Tanzania and Uganda, we are developing innovative community seed production systems with Catholic Relief Services, TechnoServe and NARS partners to support a market-led approach for grain legumes.

In natural resource management, the most significant achievement is the scaling-up of our watershed management

technology not only in India, but also in Thailand, Vietnam and China.

Building strategic public-private partnerships is the hallmark of ICRISAT. At the Agri-Science Park (ASP) we have launched commercial operations of the Agri-Business Incubator (ABI) with three private sector partners. These are Rusni Distilleries Pvt. Ltd, Bioseed Research India Pvt. Ltd and Seed Works India Pvt. Ltd. The Government of Andhra Pradesh has approved a grant of 3 crores to support development of the Agri-Biotech Park over five years.

Our Hybrid Parents Research Consortium has grown to 29 private sector seed companies from India, Indonesia and Egypt. This is expected to generate US$2.3 million over five years. Thirteen private sector companies have agreed to become partners in the ICRISAT-Private Sector Bio-pesticide Research Consortium, scheduled to start in January 2005.

Our ties with our host country India have grown even stronger. Recently, ICRISAT was visited by the Andhra Pradesh Chief Minister, Dr Rajasekhara Reddy. The CM asked ICRISAT to promote our sweet sorghum on a large scale in the State. The Indian Council of Agricultural Research (ICAR) has been one of our strongest partners. We are confident that ICAR and ICRISAT will scale greater heights with India's increasing financial support to ICRISAT.

We are building a virtual and seamless organization with integrated systems and processes by harnessing ICTs. The Virtual Academy for the Semi-Arid Tropics (VASAT) has taken off in West Africa. To reach out to more farmers, we revived our Farmers Days, at Dharwad in Karnataka and Karivemula village in Kurnool district of Andhra Pradesh.

The Governing Board recently approved a strategy on Intellectual Property Rights, protecting ICRISAT's breeding lines, research methods, processes, technologies and gene constructs. Starting this year, we conducted in-house reviews for WCA, ESA and Asia reflecting our priorities, impact on farmers, strategic partnerships, science quality and future challenges.

Our team-building efforts are now paying off. Today, with our renewed vision, focus and stability, staff morale and productivity are high. Obstacles have not deterred TEAM ICRISAT. There have been walls in front of us, but we have not turned back. We never gave up. By working together, TEAM ICRISAT has overcome these obstacles and turned them into opportunities.

We will continue to enhance the culture of innovation, collective action and change. We will have to scale new heights beyond our comfort zones. In innovation and experimentation, failures are acceptable but mistakes can't be tolerated. We will also celebrate failures but more so our successes.

TEAM ICRISAT has indeed sown the seeds of success in the semi-arid tropics. We are soaring high because of our achievements, we keep innovating, we deliver and thereby create more impacts. With your cooperation and hard work, let us surge even further and reap them on behalf of the rural poor!

Thank you and good day.

About ICRISAT

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

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