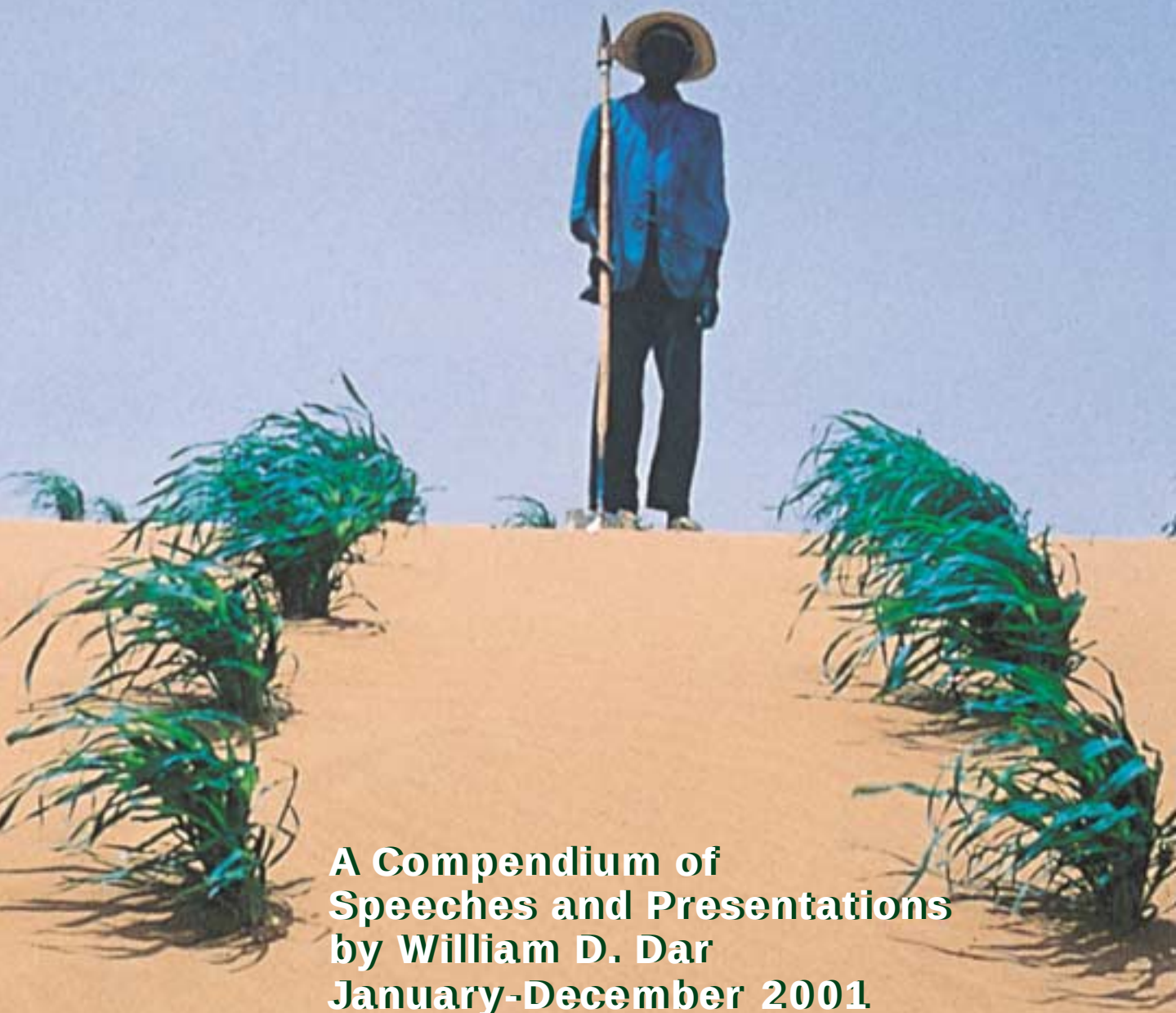
Towards a Grey to Green Revolution

Turning Adversity into Opportunity



A Compendium of Speeches and Presentations by William D. Dar January-December 2001

International Crops Research Institute for the Semi-Arid Tropics

Towards a *Grey to Green Revolution*

Turning Adversity into Opportunity

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January–December 2001

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

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Director General, ICRISAT
Biographical Sketch*

William D Dar has been 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 sixteen international agricultural research centers supported by the Consultative Group on International Agricultural Research (CGIAR).

Prior to joining ICRISAT, he served as Presidential Advisor for Rural Development, and as Acting Secretary of Agriculture in the Philippines (equivalent to Minister of Agriculture). He has served on the managing boards of the Australian Centre for International Agricultural Research (ACIAR), the CGIAR's International Maize and Wheat Improvement Center (CIMMYT), and of ICRISAT. He was Chair of the Asia-Pacific Association of Agricultural Research Institutions (APAARI); Chair, Coarse Grains, Pulses, Roots and Tuber Crops (CGPRT) Centre based in Indonesia; 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).

Dar received an MS in agronomy from Benguet State University (BSU) in La Trinidad, the Philippines, and a PhD in horticulture from the University of the Philippines, Los Baños (UPLB). He taught at BSU for 11 years and held the rank of Professor. He has also received a number of awards and honors, including Ten Outstanding Young Men (TOYM) of the Philippines from the Philippine Jaycees, Outstanding Young Scientist of the Year from the National Academy of Science and Technology in the Philippines, Crop Science Society of the Philippines' Achievement Award for Research Management and as Outstanding Science Administrator given by the Philippines Department of Science and Technology (DOST). He was also recognized as a Distinguished Alumnus of UPLB and the Most Outstanding Alumnus of BSU. Since he joined ICRISAT, he has been advocating a *Grey-to-Green Revolution* in the dry areas of the developing world through *Science with a Human Face.*

**As of January 2002*

Foreword

Since Dr William D Dar assumed the stewardship of ICRISAT in January 2000, the Institute's vision, mission, strategy, and organizational system have dynamically evolved to have a stronger impact on the poor of the drylands.

ICRISAT's directions towards change are anchored on *Science with a Human Face*, the compendium's theme in 2000, and a *Grey-to-Green Revolution,* the focus in 2001.

These two themes are intertwined, for the former cannot be pursued without the latter.

Many have asked whether it is possible to turn grey areas to green. Thanks to the support of our many partners, we are happy to report significant progress. Through the *Grey-to-Green Revolution,* we are empowering the poor of the drylands to effectively grow their way out of poverty.

We believe that the key to our success has been to adapt cropping systems to the natural variability of the environment. Rather than being overcome by adversity, we are helping empower farmers to meet the challenges that confront them.

Adapting the crop to the environment allows farmers to optimize their own natural resource endowments. This approach also enables them to compete in an increasingly globalized market.

As a member of the ICRISAT family, I am very happy to render the Foreword to this compendium of speeches and presentations by Dr Dar. This document will serve as a valuable guidepost as we pursue our new vision, mission, strategy, and organizational system to empower the poor of the drylands.

Let us work together to embrace the *Grey-to-Green* way!

Martha B Stone
Chair, ICRISAT Governing Board

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Chickpea Breeders' Meet

Inaugural Address, at the Chickpea Breeders' Meet, 10-11 January 2001 ICRISAT, Patancheru, Andhra Pradesh, India

Dr Masood Ali, Director, Indian Institute of Pulses Research, Kanpur; chickpea breeders and other scientists from all over India; chickpea scientists from other countries, particularly from Canada, Bangladesh, Iran, and Tanzania; Jagdish Kumar and other scientists from ICRISAT; ladies and gentlemen, I have great pleasure in welcoming you all to ICRISAT.

It is a matter of great satisfaction that the ICAR-ICRISAT collaboration has taken this initiative to enable you all to interact on chickpea, improvement. This meet will also enable you to select useful breeding materials developed at ICRISAT. India grows 70% of the world chickpea and any progress we achieve together to improve this crop will benefit a large section of the farmers and consumers not only in this country, but also in South Asia and worldwide. This early, let me mention the case of chickpea in Canada. There has been a very significant spillover effect with the research we do on this commodity. From almost zero hectarage six years ago, today Canada is devoting 300,000 ha to chickpea production using the cultivars that we developed.

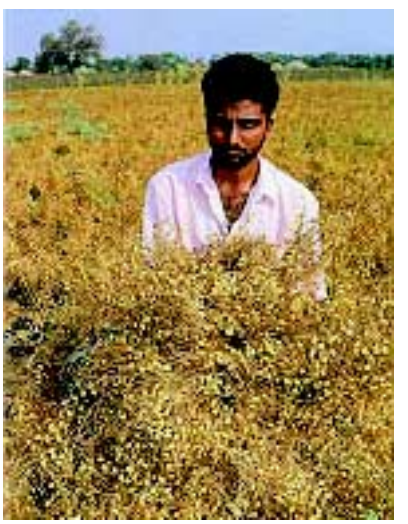
Large increases in cereal production as a result of the Green Revolution in India and elsewhere have made chickpea a less favored crop in irrigated areas. This crop lost more than a million ha in the Indo-Gangetic plains. The area under chickpea and other legumes has shifted to wheat, rice, and oilseeds in this region. But the cereal-cereal rotation is detrimental to long-term sustainability of agricultural productivity and soil health. This has resulted in an imbalance in the availability of cereals and pulses. The quality of nutrition of the people has been affected. Large-scale use of chemical

fertilizers to get high yields can be harmful. On the other hand legumes, often called mini-fertilizer factories, can fix atmospheric nitrogen.

Chickpea, a long rooted crop, has the advantage that it can draw water and nutrients from deeper layers and therefore will grow in lands where other crops may require much more water. The challenge before you, therefore, is to increase the productivity and stability of chickpea so that it becomes comparable to the competing crops.

It will help if we breed chickpea that has drought tolerance. As the crop is mainly grown rainfed, short-duration varieties will be useful in escaping end-of-season drought. In addition we can breed for resistance to fusarium wilt, ascochyta blight, botrytis gray mold, pod borer, and tolerance to chilling temperatures.

The scientists at ICRISAT in collaboration with some of you have made advances in developing short-duration genotypes that escape drought, are resistant to fusarium wilt, and are tolerant to ascochyta blight. We have also bred kabuli types that can grow in the tropics. These have undoubtedly increased productivity, stability of production, and the income of farmers in Central and Peninsular India. The popularity of some of the short-duration cultivars such as Sweta (ICCV 2), Kranti (ICCC 37), and Bharati (ICCV 10) is shown by over 80 t of breeder seed indented by State Seed Corporations in Central and Peninsular India over the last four years.



Development of super early chickpea ICCV 96029, that matures in 75-80 days in Peninsular India, provides further opportunities to extend chickpea to even drier areas and escape end-of-season drought. The release of fusarium wilt-resistant, large seeded, and short-duration kabuli variety KAK 2 (ICCV 92311) will help raise farmers' incomes. Such developments will help extend the crop to fallow lands, increase productivity and income, and enhance sustainability of agriculture in some of the most deprived regions of the world.

ICAR-ICRISAT scientists need to develop short-duration chickpea for subtropical conditions as well, so that the crop matures in about 120-

130 days instead of the normal 160-180 days taken by currently available cultivars. The reduction in duration may help the crop escape end-of-season stresses. This development may enhance the productivity and stability of the crop in target areas and could bring more area under legumes in the Indo-Gangetic plains. It is necessary that chickpea becomes a regular part of the crop schedule in this highly fertile region and helps farmers raise their incomes and address the soil health and environmental problems.

In recent years ICRISAT has focused more on basic and strategic studies so that a strong foundation is laid for a sound improvement program around the world. Such information is lacking with regard to chickpea. Thus more genetic information, molecular markers, and genome maps have been generated and published in recent years. Such studies could lead to marker-assisted selection and multiply the power of plant breeding. The breeders may develop more efficient varieties as they will be able to move genes and quantitative trait loci more efficiently. I encourage you and ICRISAT scientists to further strengthen such studies and help enhance chickpea improvement.

I am sure your deliberations will address the poverty, productivity, nutrition, and environment issues that are so important to the survival and well-being of the people, as well as improvement of the livelihood opportunities of people living in harsh environments like those of the semi-arid tropics of the world.

Mixed Crop - Livestock Systems: a Must for the SAT

Workshop on Documentation, Adoption and Impact of Livestock Technologies in India, 18 Jan 2001, ICRISAT, Patancheru, Andhra Pradesh, India

Good morning to you all. I am very pleased to welcome you to ICRISAT and to this workshop on *Documentation, Adoption, and Impact of Livestock Technologies in India.* This workshop is being organized jointly by Dr Parthasarathy Rao of ICRISAT's Socioeconomics Policy Program and Dr PS Birthal of the National Centre for Agricultural Economics and Policy Research (NCAEPR), ICAR under the project, 'Increasing Livestock Productivity in Mixed Crop-Livestock Systems in South Asia'.

I am happy to note that the Indian Council of Agricultural Research (ICAR) is one of the stakeholders in this project as a regional partner. And I understand there are seven directorates of ICAR on crops and livestock represented by their Directors participating in this workshop. From the beginning, our partnership with ICAR has been the cornerstone of our strategy. This strategic partnership has strengthened over the years and now we meet twice a year with ICAR to review our joint projects. In recent years we have been expanding the scope of our partnerships to include an even wider range of organizations. These include agricultural universities, nongovernmental organizations, and the private sector. Yes, our partnership with the Indian NARS has been very successful and productive.

At ICRISAT, our mission is to achieve higher farm productivity and sustainability by genetically improving our mandate crops and developing appropriate natural resource based technologies for the semi-arid tropics. ICRISAT's research mantra is *Science with a Human Face*, meaning we carry out research not for the sake of science, but for improving the well-being of humankind in the semi-arid tropics.

Although ICRISAT is primarily a crops research institute, it now has a special interest in livestock in the SAT through our Natural Resources Management Program. Diversification is key to SAT. Livestock are important components of the mixed farming systems in the SAT where ICRISAT works, providing draft power, organic matter, and income for the resource-poor farmers. All of the mandate crops of ICRISAT, particularly sorghum, millet, and groundnut provide residues for animal feed and their value for livestock is given special attention in our crop improvement program.

In recent years per capita demand for milk and meat has increased manyfold. This trend is expected to continue due to growth in incomes and urbanization. The increased demand for milk and meat is linked to increased demand for fodder, as fodder is an important input in milk and meat production. Breeding for increased quantity and improved quality of stover is necessary to meet these challenges. In addition to emphasizing these crops for food use, breeding strategies will also meet the growing demand from the animal sector.

To meet these challenges, ICRISAT scientists together with ILRI and national partners, are working on several projects related to stover quantity and quality. These include:

- effects of environmental conditions on stover quality.
- plant traits associated with improved stover quality.
- breeding for improved pearl millet cultivars for higher stover yield and feed quality.
- identification of molecular markers for improved stover quality in pearl millet, grain quality associated with meat and egg production.
- feed and fodder quality as affected by diseases.

Our Natural Resources Management Program continues to address issues in the identification and promotion of crop, agroforestry, and livestock options for the intensification of mixed farming systems in the SAT. To better target the research to farmers' needs we also carry out surveys to assess farmers' perception of fodder quality traits.

Significant research advances have been made in the areas of animal breeding, health, and nutrition. Many of the technologies have proved successful under controlled experimental conditions but their adoption at farm level has remained poor. We need to enhance technology exchange but be conscious of the constraints of adoption.

We should be able to tap new tools such as information technology to reach the poor farmers in developing countries. The farmers must have access to technologies and other production inputs to be able to make decisions. One of the objectives of the crop-livestock project is the construction of a crop-livestock typology to delineate homogenous regions/zones that would have similar response to development initiatives and policy prescriptions. This would help in better targeting existing and future technologies aimed at improving animal performance. I am sure your deliberations at this workshop will bring out some useful researchable issues for both biological and social scientists. May these research activities bloom to benefit the poor people of the SAT of the world under the aegis of the second green revolution that we must support and enhance.

I once again welcome you, and wish all of you a productive and comfortable stay at ICRISAT.

Integrated Watershed Management: Key to Sustaining SAT Productivity

Farmers' Training on Integrated Watershed Management, 7 February 2001, ICRISAT, Patancheru, Andhra Pradesh, India

Ladies and gentlemen,

I am very happy to warmly welcome Mr Ajay Jain, Collector, Ranga Reddy district, who is visiting us at ICRISAT for the first time. I also welcome Ms Sridevi, Director, Drought Prone Area Project (DPAP), RR district, and other officials. I am very pleased to also welcome the most important group of our target clients – the farmers. Likewise, I would like to recognize the efforts put up by our colleagues led by Dr SP Wani in organizing this training.

Some of you must have visited ICRISAT before, but for many of you this may be the first visit, and I appreciate the efforts of the DPAP director and other officials who have arranged this training visit for you. ICRISAT is the International Crops Research Institute for the Semi-Arid Tropics. We work for the poor farmers like you in the semi-arid tropics of Asia and Africa. Our mission is to ensure food security and reduce poverty through increasing the incomes of farmers by doing science with a human face. We adopt a systems approach for developing sustainable practices for rainfed agriculture. And I'd like to mention this early that integrated watershed management is key to sustaining the productivity of the SAT of the world.

Water is one of the most critical resources in the SAT. Most of the SAT receives sufficient amount of water through rainfall. However, temporal and spatial variability in rainfall results in too much of water sometimes in the season, and too little water at other times during the crop growth. You have experienced in the last year that in two days, RR district received more than 400 mm rainfall, which was equivalent to 75% of the total rainfall received in the previous year. The message which nature gives us is that water is enough provided we learn to manage it properly and use it most efficiently for agricultural production. If we do not

manage it properly, then not only is the precious water lost, but along with it takes away top fertile soil causing severe land degradation.

For managing water effectively, the most appropriate land unit is the watershed. At ICRISAT, we have evaluated an integrated watershed management approach for the last 25 years for rainfed farming systems. Our results showed that at Patancheru, deep black soils could grow two crops during rainy and postrainy seasons, and produced on an average 4.7 t sorghum-pigeonpea or maize-chickpea grains per ha.

Through the watershed management approach we could use 65% of the rainfall for crop production whereas in nontreated fields only 30% rainfall was used for producing 900 kg of sorghum grains per ha. Through improved management, soil loss was reduced to 1.5t ha^{-1} as against 6.4 t ha^{-1} from untreated areas. We have grown different crops such as soybean, sunflower, safflower, sorghum, maize, cotton, pigeonpea, chickpea, and groundnut under rainfed conditions.

Further, this work has been currently evaluated in on-farm watersheds in India, Thailand, and Vietnam. One of the on-farm watersheds in India is in your district at Kothapally. Farmers in Kothapally are very happy with the watershed development activities carried out during the last two years. They have harvested up to 4.2 t ha^{-1} maize and pigeonpea yields, and their well water levels have improved. They are using less pesticides and trying new methods of preparing compost from farm residues.

I am happy that DPAP has decided to spread the Kothapally model to other watersheds in the district. This training program will expose you to the work we have done at ICRISAT and also in Kothapally along with our partners. In Kothapally, farmers are our main partners. I hope that you will interact with our scientists and learn how to effectively manage your watersheds. Let us join together and make the watershed management program most productive and beneficial for increasing the incomes of poor farmers who depend on rainfed situations.

I would like to see the day that the work that we are doing together starting now and in the future will trigger the enhanced adoption of the integrated watershed management approach all over Andhra Pradesh, if not the whole of Indian SAT, and even the world. This is a seed of the Second Green Revolution for the dry and marginal areas like the SAT. I hope everyone here today shares this dream.

Thank you.

Multiplying our Comparative Advantages through Regional Integration for a Food-Secure South Asia

Welcome Address, 1 March 2001, ICRISAT, Patancheru, Andhra Pradesh, India

Colleagues and friends, welcome to ICRISAT. The regional research integration meeting that we are conducting for the next three days will be very important for South Asia, particularly the poor people.

South Asians are known everywhere for their close-knit family ties. Over centuries, such ties have helped family members to share their problems and strengths, and harmonize their aims for a better future. Such bonds have also acted as safety nets for the families during crises.

We can draw lessons from this model to tackle the two biggest challenges facing South Asia today – the specter of poverty and hunger. Many world leaders do not realize that South Asia alone is home to half the developing world's poor. Together, Bangladesh and eastern India have as many poor as all of sub-Saharan Africa.

While stark pictures of poverty and hunger in Ethiopia and Somalia have been permanently engraved on the world's conscience, the longstanding suffering, hunger, and hopelessness of South Asia's desperately poor have been somehow overlooked.

In its recent report on the *State of the World 2001*, the Worldwatch Institute has revealed frightening figures on the number of poor in this region. The report states that in South Asia, 522 million people live on less than $1 a day, which is a "staggering number of people to enter the new century without the income needed to purchase basic necessities such as food, clean water, and health care."

Describing the Indian subcontinent as "the hungriest region on Earth," the report said that another 787 million people are expected to add to the population by mid-century. "Within the Indian subcontinent, most of the hungry live in the countryside, and because most of them are undernourished, many are sentenced to a short life."

Half a century ago, the fear of famine in Asia compelled humanitarian leaders to create and support international agricultural research centers. However, we are now faced with an even more daunting challenge. We have to help this region produce more food, but in a much more complex and fragile world – with no more new land, and less water every day.

During his recent visit to ICRISAT, Mr Ian Johnson, CGIAR Chair, said "CGIAR has a very good platform to deal with such issues and challenges. We have great opportunities to recreate ourselves into being an institutional framework for this century and being able to pull together various talents we have across the world in very creative ways."

I think this meeting on South Asian Regional Integration is one such creative way for taking our partnership to a higher dimension.

ICRISAT's new Vision and Strategy (under formulation), a reassessment of ICRISAT's research agenda for the new millennium, resonates in particular with the growing regional cooperation among Centers (emanating from the new CGIAR Vision and Strategy). Closer regional cooperation will enable more holistic approaches to poverty reduction, livelihood enhancement, and integrated natural resource management.

As you are aware, to streamline and enhance partnerships and impact, CGIAR Center Directors General have agreed to move towards closer regional integration, including research, research support, and administrative functions. This commitment is embodied in the seven planks of the new CGIAR Vision and Strategy, adopted at MTM-2000 in Dresden. In brief the seven planks are: poverty alleviation, use of modern science, priority to south Asia and Sub-Saharan Africa, regional approaches to research planning, integration of CGIAR activities with partners in developing regions, adoption of a task force approach, and service as a catalyst within the global agricultural research system. We initiated one earlier for West and Central Africa during the MTM 2000 where IITA, WARDA, and ICRISAT signed an aide memoir to institutionalize the regional process.

At International Centers Week in October, Center Board Chairs and Center Directors Committee endorsed the process, as did the leaders of African National Agricultural Research Systems (NARS). Shared understandings reached at the Meetings of Minds I & II (May 1999 in

Nairobi and September 1999 in Dakar) to enhance CGIAR-NARS partnership in sub-Saharan Africa also provided a vital underpinning for the process on that continent.

Follow-up meetings of the Directors General have advanced the regional concept, and delegated implementation responsibilities to the Deputy Directors General or designated representatives. Regionalization will be a participatory process, bringing local and regional as well as global knowledge to bear on the problems of the poor, and to elicit ownership and commitment among partners.

As part of South Asian regional integration development, the Center Directors asked ICRISAT to convene the South Asia process. Thirteen CGIAR Centers (CIMMYT, IRRI, ICRISAT, IWMI, ILRI, IPGRI, CIP, ICLARM, ICRAF, ICARDA, IFPRI, CIFOR, ISNAR) plus three affiliated centers (AVRDC, ICIMOD, and ICBA) have asked to be involved, including TAC. NARS partners and their regional forum APAARI, as well as NGOs, the private sector, and development organizations, will also be engaged at a later time.

The regionalization concept entitled *Strategy for a Regional Partnership among CGIAR Centers in South Asia* was presented to the Sixth General Assembly of APAARI and Expert Consultation on Strategies for Implementing the APAARI Vision 2025: Agricultural Research for Development in the Asia-Pacific Region, at its meeting in November 2000 in Thailand. APAARI members appreciated the initiative, because they believe that such partnerships among the IARCs are essential to improve the complementarities and effectiveness of their programs in the region. During the discussions, it was clear that the NARS would like to avoid duplication of efforts, and coordinate research and development in a way that will allow a holistic approach to sustainable production and natural resources management. The General Assembly endorsed the regional partnership approach and suggested that it should involve the NARS and other stakeholders in the region in research planning and prioritization.

Subsequently, we have received a request this week from APAARI reiterating that the research and development priority setting be done jointly involving NARS, IARCs, and other stakeholders in each subregion of the Asia-Pacific region. APAARI has proposed to co-host and co-sponsor a joint meeting in June 2001 to do this. I think this is a good opportunity to move forward in this exercise, and we must respond positively to APAARI's proposal.

No one understands the harsh realities of South Asia better than the prominent thinkers and leaders we have here with us today. We treasure the value of your experience, wisdom, and creative ideas to fulfill the promise of a food-secure South Asia. I am sure we will have stimulating and result-oriented deliberations.

Thank you.

Uplifting Rural Livelihoods through a Second Green Revolution

Address at the National Institute of Rural Development, 29 March 2001, Hyderabad, Andhra Pradesh, India

Mr RC Choudhury, Director General of NIRD, distinguished academicians, scientists, policy makers, and participants of this training program, ladies and gentlemen, I feel extremely privileged to address you this afternoon.

This session marks the culmination of an extremely laudable initiative launched by the National Institute of Rural Development (NIRD) in collaboration with the Colombo Plan Secretariat (CPS). Human resource development, oriented to the socioeconomic developmental needs of the member countries in the Asia Pacific region, is the focus of the Colombo Plan and the Plan Secretariat has been performing a commendable job in the furtherance of this objective.

The NIRD is one of the premier institutions dedicated to the cause of rural development in this part of the world. It is only appropriate that both these institutions have joined hands to organize this international training program on a theme that is so very critical to development and poverty alleviation not only in the member countries, but the world over. Sustainable Rural Development is the key to addressing the multitude of issues confronting the developing world, be it poverty, food insecurity, malnutrition, population explosion, or environmental degradation.

According to the Global Economic Prospects Report of 2000, one-third of the population in developing countries lives below the poverty line, which in absolute terms, translates to a staggering 1.2 billion. Of this, 75% or one billion, live in the rural areas. A sizeable proportion of the rural poor live in low-potential, environmentally vulnerable marginal regions.

Allthough the Green Revolution signaled the importance and power of modern technology in enhancing agricultural productivity, thereby

addressing the issue of food security to a great extent, there has been the realization that the fruits of the Green Revolution did not fully trickle down to the dry and marginal rural farmlands to make any significant dent in the lives of the poorest inhabitants of these areas. The Green Revolution mostly covered the relatively better endowed regions and had its impact mainly on cereals more responsive to inputs such as fertilizer and irrigation. The farmers that could not afford these inputs were naturally left behind. It was therefore no surprise that the gap between the rich and the poor, the large and the marginal farmers, the urban and the rural areas, and the irrigated and the dry farmlands kept widening.

We in the scientific community could not afford to rest on our laurels and ignore this divide. It was in response to the crying needs of a large part of the world population that had been bypassed by the Green Revolution, particularly those who lived in the harsh dry lands of the backward rural areas, that the world community set up ICRISAT, the International Crop Research Institute for the Semi-Arid Tropics supported by the Consultative Group on International Agricultural Research (CGIAR), to cater to the marginal areas in the semi-arid zones known as the SAT. Sixty-six percent of the total rural poor in developing countries rely on marginal agricultural lands.

ICRISAT helps developing countries apply science to increase agricultural productivity and food security, reduce poverty, and protect the environment in the fragile ecosystems of the SAT, where low and erratic rainfall is the major environmental constraint to agriculture. Home to one-sixth of the world's population, of which half lack access to even basic health and nutrition, the semi-arid tropical regions include parts of 48 developing countries in Africa, Asia, and Latin America. They are characterized by stubborn poverty, persistent drought, infertile soils, growing desertification, and overall environmental degradation. Agricultural production struggles to keep pace with alarming population growth. Farming is mostly subsistence level.

The Asian Development Bank (ADB), in a study carried out last year, concluded that environmentally sustainable agricultural growth is a prerequisite for economic development in general and rural development in particular. The ADB study inferred that in order to improve the overall quality of life in rural areas it is necessary to go beyond growth, poverty, and environment considerations and directly address specific concerns of particular relevance to the rural areas. On poverty and environmental grounds alone, more attention

will have to be given to less favored lands in setting priorities for policy and public investments. Econometric analyses reveal that carefully targeted investments in marginal areas deliver comparable or even greater returns than in more favorable areas. The successful development of less favored rural areas will require new and improved approaches, particularly for agricultural intensification.

The challenge before us today is, how to replicate the Green Revolution in less hospitable rural agroecoregions and bring about food security to the poorest of the poor of its inhabitants? Another revolution is the need of the hour – we may call it the second Green Revolution, or the Evergreen Revolution (as Dr. Swaminathan calls it), or the *Grey-to-Green Revolution*. The challenge is greater than that of the Green Revolution. It is not just the technology that can achieve it – it is the commitment, the will and desire to make a difference, the humane attitude, all of which are as important. This is the theme we have ingrained into the foundation of our activities – what we at ICRISAT call *Science with a Human Face*.

The Second Green Revolution cannot be accomplished without the help of a revolution of another kind – the revolution in biotechnology and information technology. Information is optimal use of available resources. Information technology will play the crucial role of enabler of this process. The advent of new science has presented an array of extremely powerful tools. Biotechnology, for instance, has the potential of substantially increasing the rates of return on investments in genetic improvement. There are synergies between the advances in DNA sequencing, genome analysis, and bioinformatics. The identification of genome sequences is facilitated by information technology – a number of genome sequences are already available on the internet. Functional genomics and recombinant DNA technology offer the prospect of progress in this endeavor by exploiting interspecific genes in transgenic manipulation. Given the emerging constraints of water availability, new sciences offer exciting new opportunities. Application of new science in natural resource management includes diagnostic research to explain the functioning of natural systems and allow the construction of crop and system simulation models particularly relevant as a complement to other R & D approaches. Many rural regions do not have the infrastructure to be able to benefit from technological advancements, warranting different R & D strategies depending on ground realities.

A Millennium Without Hunger was the focal theme enunciated by the FAO at the dawn of this millennium. Food availability and food access are two dimensions of food security and the significance of a third one,

namely nutrition, is also coming into focus. Availability of food is a function of production, and access is a function of purchasing power. Nutrition is determined by the availability of safe drinking water, primary health care, and environmental hygiene. Child malnutrition is the most menacing manifestation of food insecurity. While the focus of conventional agricultural research has been on agricultural production which has a direct bearing on food availability, I believe that our vision has to extend to encompass the entire gamut of the issue – water, crops-livestock integration in farming systems, commodity vs. systems approach, rural livelihoods and augmenting purchasing power, postharvest technology, biotechnology impacts, future of the national systems, feminization of agriculture, land degradation, impact of AIDS on rural agriculture, especially in Africa and Asia, and so on – it is a formidable list of challenges that can be tackled only with the human face of science I referred to earlier.

The most vulnerable groups in the rural sector are small farmers, the landless, women, artisans, and craftsmen. Smallholder farmers and the landless represent 90% of these groups. Seventy percent of them are women. The ADB study found that in many Asian countries the combination of high female involvement in agriculture and the large gender gap in schooling, literacy, health, social participation, and agricultural wages not only puts rural women at disadvantage vis-à-vis rural men, but also compared to urban women. No rural development initiative can succeed without steps to empower women through emancipation and provide economic independence to them so that they are actively involved in decisions relating to their own lives. A holistic approach to integrated rural development has necessarily to target promoting growth of the rural nonfarm economy with emphasis on village and cottage industries and micro enterprises so that the vulnerable group of landless, artisans, and village craftsmen can break free from the vicious cycle of unemployment, poverty, and hunger.

Technology driven, community-based, decentralized rural institutions will hold the key to coordinating the efforts towards uplifting rural livelihoods. The technology has to be environmentally sustainable, and will largely be powered by the new science tools I referred to earlier – what I call the *green* technology, providing another vital dimension to the second Green Revolution. This is where dedicated rural development institutions like the NIRD and technology centers like ICRISAT can work together. Closer regional cooperation will enable more holistic approaches to poverty reduction, livelihood enhancement, and integrated natural resource management. Partnership is an important cornerstone of ICRISAT's operations. We are committed to strengthen partnerships and work hand

in hand with NARS and sister CGIAR centers, the universities, rural development institutions, the private sector, extension departments, farmers' organizations, donor agencies, policy makers, NGOs, advanced research institutes, and regional organizations and networks. We weave all these relationships together through networks focused on specific problems. At a regional level we participate together with India and its neighbors in an association of Asian national research systems known as the Asia Pacific Association of Agricultural Research Institutions (APAARI). The regionalization concept is a vital input into the *APAARI Vision 2025*.

It is clear that a holistic approach towards integrated, sustainable rural development has to be supported by a strong convergence strategy. The government and the public sector will have to catalyze rural development efforts with the active participation of civil society. The policymakers should ensure that all basic services target the rural areas. A study by the International Food Policy Research Institute pointed to the significance of investment in developing infrastructure areas such as roads, energy, water, transport, education, and healthcare in spurring rural development.

It is also important for the private sector to play a progressively important role by enhancing investment flow into convergence areas. The private sector has to eventually take leadership to promote development of convergence areas. I stressed the importance of partnerships earlier. I would like to underscore the fact that in order for the convergence strategy to succeed, the public, the civil society, and private sector have to work in tandem. For the private sector to actively embrace such partnerships, especially in R&D areas, intellectual property rights issues should not be a constraint – they have to be assured of protection of proprietary technology.

I am sure this program has been a great learning experience for the array of senior administrators, policy analysts, and chief executives who have come together from various CPS member countries. The NIRD and the CPS deserve all praise for facilitating valuable interaction and intellectual exchange among this distinguished group, which will help understand and analyze the dynamics and determinants of the grave problems of the rural world, and harness the knowledge, information and understanding gained to refine strategies and assess priorities and impacts. I believe that together we can make a difference to the livelihoods of the millions of underprivileged and the deprived in the marginal rural areas of the developing world. Let us move from counting the poor to making the poor count!

Thank you.

Towards a Second Green Revolution

Convocation Address at the 35th Annual Convocation of the University of Agricultural Sciences, 30 March 2001, Bangalore, Karnataka, India

Her Excellency Mrs VS Rama Devi, Governor of Karnataka and Chancellor of the University of Agricultural Sciences (UAS) Bangalore; Honorable Minister for Agriculture Mr TB Jayachandra, Government of Karnataka; Dr S Bisaliah, Vice-Chancellor of UAS; distinguished academicians and scientists, students graduating from UAS today, ladies and gentlemen, good afternoon.

I feel extremely privileged to deliver this address at the 35th Annual Convocation of this august institution.

Agricultural Universities play a very crucial role in providing a technological base for supporting agriculture and rural development. I am glad to note that in the three and a half decades of its existence, UAS Bangalore has had an impressive array of achievements to its credit. The University has turned out some of the most outstanding agricultural scientists in the country who have made significant contributions in bringing about the legendary Green Revolution.

Various high-yielding crop varieties released by the University have contributed substantially to improving agricultural productivity in the country. Development of diagnostics and vaccines for animal diseases, technology development for fish breeding, advances made in identifying beneficial microbial and fungal populations, popularization of vermi-compost technology, development and dissemination of technology in a wide variety of agricultural and allied disciplines etc., are some of the other achievements the UAS can rightfully be proud of.

The organization I represent, ICRISAT, or the International Crop Research Institute for the Semi-Arid Tropics regards research partnership with the National Agricultural Research Systems, including the Agricultural Universities, as a key driving force in the

pursuit of its mission – improving livelihoods of the poor of the semi-arid tropics. ICRISAT already has a few collaborative projects with the UAS in progress. For example, (1) identification and characterization of economically important viruses, including the recent peanut stem necrosis that was epidemic in Anantapur district of Andhra Pradesh, and the adjoining areas of Karnataka; (2) breeding for drought tolerance in groundnut using leaf thickness as marker; (3) collaborative breeding of high yielding, disease and pest resistant chickpea and pigeonpea varieties; and (4) developing high-yielding rabi sorghum hybrids.

The research collaboration has had significant impact on the Karnataka farmers. The adoption of fusarium wilt resistant pigeonpea variety “Maruthi” (ICP 8863) is more than 60% in the major pigeonpea growing areas of northern Karnataka, with >45% yield advantage over local varieties. The gains due to this variety in 1995 were estimated at US$ 75 million. Similarly, there are the examples of adoption of midge-resistant sorghum variety ICSV 745 and downy mildew resistant pearl millet variety ICTP 8203. Short-duration and high-yielding chickpea and groundnut varieties are in early stages of adoption by farmers.

ICRISAT aims to help developing countries apply science to increase crop productivity and food security, reduce poverty, and protect the environment. ICRISAT focuses on the semi-arid tropical areas of the developing world, where low and erratic rainfall is the major environmental constraint to agriculture. Special emphasis is placed on five crops that are particularly important in the diets of the poor: sorghum, millet, groundnut, chickpea, and pigeonpea. ICRISAT’s research strategy is oriented towards fostering research partnerships with governmental, nongovernmental, and private sector organizations and agricultural universities in the developing countries, and to link these partners to advanced research institutions worldwide. Each partner contributes its unique strengths to make the whole greater than the sum of its parts. ICRISAT excels in strategic research on global issues and on international exchanges of knowledge, technologies, and skills. These products and services help partners enhance their capabilities to meet regional, national, and local development needs.

ICRISAT, as the name suggests, has the global responsibility for agricultural research in semi-arid tropical agroecoregions. Home to one-sixth of the world’s population, of which half lack access to even basic health and nutrition, the semi-arid tropical region includes parts

of 48 developing countries in Africa, Asia, and Latin America and is characterized by stubborn poverty, persistent drought, infertile soils, growing desertification, and overall environmental degradation. Agricultural production struggles to keep pace with alarming population growth. Farming is mostly subsistence level. Most of the world's poor live in Asia, and of those, the majority live within India. The major thrust of our work, therefore, is directed at developing new technologies in collaboration with our Indian partners.

Allthough the Green Revolution signaled the importance and power of modern technology in enhancing agricultural productivity, thereby addressing the issue of food security to a great extent, there has been the realization that the fruits of the Green Revolution did not fully trickle down to the dry and marginal rural farmlands to make any significant dent in the lives of the poorest inhabitants of these areas. The Green Revolution mostly covered the relatively better-endowed regions and had its impact mainly on cereals more responsive to inputs such as fertilizer and irrigation. The farmers that could not afford these inputs were naturally left behind. It was therefore no surprise that the gap between the rich and the poor, the large and the marginal farmers, and the irrigated and the dry farmlands kept widening.

There are still about 840 million people, or 13% of the global population, for whom food security is still a dream. Forty-eight percent of the population of South Asia is still chronically malnourished. About 84% of the Indian rural poor live in the rainfed areas. We in the scientific community cannot afford to rest on our laurels and ignore this divide. It was in response to the crying needs of a large part of the world population that had been bypassed by the Green Revolution, particularly those who lived in the harsh dry lands, that the world community set up two centers supported by the Consultative Group on International Agricultural Research (CGIAR) to cater to these marginal areas – ICRISAT for SAT and our sister Center, ICARDA (International Center for Agricultural Research in the Dry Areas) for the dry temperate latitudes.

In course of time several more Centers were added to the CGIAR system to focus on a broader range of ecological issues and approaches, including agroforestry, water, fisheries, and livestock. ICRISAT has been focusing its activities on the center of peninsular India, which is a dry tropical area constituting more than 60% of India's net cropped area and sub-Saharan Africa, together home to hundreds of millions of rural poor.

The challenge before us today is to replicate the Green Revolution in less hospitable agroecoregions and bring about food security to the poorest of the poor of its inhabitants. Another revolution is the need of the hour – we may call it the second Green Revolution, or the Evergreen Revolution (as Dr. Swaminathan calls it) or the *Grey-to-Green Revolution*. The challenge is greater than that of the Green Revolution. It is not just the technology that can achieve it – it is the commitment, the will and desire to make a difference, the humane attitude, all of which are as important. This is the theme we have ingrained into the foundation of our activities – what we at ICRISAT call, *Science with a Human Face*.

No meaningful beginning can be made unless we change our mindset about the dry and marginal areas. Rather than being daunted by the problems of these regions, we need to transform these challenges into opportunities and strengths. For instance, ample sunshine and dry weather help control pests and diseases in both crops and livestock. Hardy crops such as sorghum and millet, the staple food for 50 million rural poor living in the drier zones of India, as also nutritious crops such as chickpea, make very economic use of that scarce resource, water.

The Green Revolution depended on farmers having access to favorable conditions to avoid moisture or nutrient stresses. But the lessons we have learnt in the marginal dry tropics is the opposite – that productivity gains can also be made by adapting the crop to the environment, through better stress, disease, and pest management. Pigeonpea has been shown to be more efficient than other crops in extracting phosphorus from the soil. In addition it fixes atmospheric nitrogen. By using such crops to build the soil, sustainable natural resource management can be practiced, in addition to enhancing productivity, catalyzing the Second Green Revolution.

A Millennium Without Hunger was the focal theme enunciated by the FAO at the dawn of this millennium. Food availability and food access are two dimensions of food security and a third one, namely nutrition is being increasingly talked about. While the focus of conventional agricultural research has been on agricultural production which has a direct bearing on food availability, I believe that our vision has to extend to encompass the entire gamut of the issue – water, crops-livestock integration in farming systems, commodity vs. systems approach, rural livelihoods and augmenting purchasing power, postharvest technology, biotechnology impacts, future of the national systems, feminization of agriculture, land degradation, impact of AIDS on agriculture in Africa and Asia and so on – it is a formidable list of

challenges which can be tackled only with the human face of science I referred to earlier.

These issues are not simple to tackle. The impact from efforts to address them will not be as swift and dramatic as in the original Green Revolution. Globalization will inescapably lead to changes in agriculture, most conspicuously reflected in changes in the cropping pattern. Cropping decisions will be governed by the criterion of efficiency in resource use. According to Gulati and Kelley (1999), in a globalised economy world prices become the reference point for measurement of efficiency – that is to say, efficiency is measured in terms of the cost of domestic production vis-à-vis the option of imports (grow vs. buy). What is needed is to adapt the cropping systems to the constraints of the agroecozones to harness the limited resources. The econometric analysis of district level data in India by Fan and Hazell (1999) reveals that carefully targeted investments in marginal areas deliver comparable or even greater returns than in more favorable areas.

A study by the Asian Development Bank in 2000 corroborates this hypothesis. Gulati and Kelley see opportunities for Indian agriculture in the new dispensation. According to them India's agricultural exports and imports would go up and the net trade balance on account of agriculture can improve by as much as 40%. Overall, India would be a net gainer from trade liberalization and rural incomes would rise. The efficiency indicators analyzed by Gulati and Kelley reveal that dryland crops such as sorghum, chickpea, and pigeonpea are quite efficient in resource utilization. In a globalised scenario, these crops are well placed not only to compete against imports, but some of them also afford potential for exports, thus raising farmers' incomes.

The second Green Revolution cannot be accomplished without the help of a revolution of another kind – the revolution in biotechnology and information technology. Gordon Conway of the Rockefeller Foundation (1999) stressed the importance of biotechnology as a tool capable of launching a 'doubly green revolution' that can add further productivity gains while also protecting the environment. Information is becoming a vital resource for farmers to take well-informed and timely decisions to make optimal use of available resources. Information technology will play the crucial role of enabler of this process, together with new science tools such as GIS and modeling.

Bangalore has emerged as the Information Technology capital of India. The UAS Bangalore enjoys tremendous comparative advantage to

exploit the exciting potential of this powerful tool and ensure that the students graduating from this eminent center of learning stay in the forefront of cutting-edge science. The community's expectations from budding scientists like you are very high. I am sure that you will rise to these expectations and contribute your might towards realizing the dream of a second Green Revolution. ICRISAT is committed to strengthen its partnerships and work hand in hand with NARS, the Universities, other public institutions, the private sector, extension departments, farmers' organizations, policy makers, NGOs, advanced research institutes, regional organizations, and networks in its tireless endeavor to bring about food security and environmental stability in the dry and marginal areas. Together we can strive to free the millions of underprivileged humans inhabiting these areas from the vicious grip of poverty.

It is a great honor for me to be invited as the Chief Guest of this Convocation today. I consider this honor recognition of ICRISAT's work in the field of agricultural research, spanning more than a quarter century.

I wish the UAS Bangalore and the batch of young scientists graduating from the UAS today god speed and all the very best in their endeavors, and extend ICRISAT's hand of partnership in the pursuit of our noble missions.

Thank you.

Perspectives on Public-Private Sector Interaction: the Way for the Future

Welcome Address during the Workshop on 10 April 2001, Patancheru, Andhra Pradesh, India

Our partners from the private sector, our partners from the NARS led by Dr Mruthyunjaya, NCAP Director, colleagues, Dr Hall, friends, ladies and gentlemen, welcome to ICRISAT !

In agricultural research systems around the world, the roles of the public and private sectors and the relationship between them is changing. This has been partly due to the re-evaluation of the role of the State in providing research services and the need to improve the efficiency of public sector research agencies. This has partly been a response to the expanding R&D capability of the private sector, and the associated intellectual property regimes and a more liberal trade and economic environment. Today, in general, the private sector is leading in new sciences like biotechnology and information technology.

These changes have highlighted the possibilities of privatizing some of the public institutions and functions and reassessing the role of public and private sectors. However it is now recognized that it is important to examine the patterns of interaction between the two sectors, focusing on the necessary adjustments to be made to achieve the goals of the public sector in its new and evolving role.

It is now widely recognized that in the next decade international efforts to apply science to the problems of the world's poorest will be characterized by the joint efforts of the public and private sectors.

At ICRISAT we have known for a long time that the private sector is a critical mechanism for delivering our seed-based technology to poor people. However in recent years the expansion of private research capability, associated with new technology, and a more encouraging policy environment, has prompted us to take a fresh look at this relationship.

What we see are many opportunities to enhance the impact of agricultural research on the poor. We see new opportunities for skill, knowledge, and cost sharing. We recognize the complementarity of agendas and physical and human resources. Together, this can contribute to the development of new technology and its delivery to those who need it.

But we also recognized that new relationships cannot emerge overnight. They need to be founded and nurtured on trust and transparency. Often there is a need to make changes to accommodate the working practices and preferences of new partners. Similarly issues of intellectual property rights, confidentiality, and public interest must be considered, discussed, and negotiated.

At the same time we do not want to lose sight of the importance of our existing partnership with the NARS. And in fact the NARS are also engaged in re-evaluating their relationship with the private sector. There are many experiences and concerns that we each have.

At ICRISAT we are fortunate that we started in a small way our relationship with the private sector in India and that 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 novel for the CGIAR as a whole. We hope that it marks the beginning of a new era for the institute and that we can further expand collaboration on topics that are at the interface between public and private interests and expertise.

Dr G Harinarayana, Director Research, Ganga Kaveri Seeds Private Limited, Hyderabad summed up his perceptions on the partnership with ICRISAT at a presentation made to the Chairman of CGIAR Dr Ian Johnson on 11 Feb 2001.

I quote “Excellent finished products and pipeline products, competent expertise, commitment, impartiality, and above all a willingness to share have contributed to better understanding between ICRISAT and private sector”. This is a good testimony and good example based on the principle of participation, sharing, and exchange. We would like to continue with such partnerships for the benefit of the poor farmers in SAT. The consortium of private seed companies working with ICRISAT today exemplifies a true strategic partnership for the poor worth emulating and enhancing. This can be a seed in pursuing a grey-to-green revolution to dry and marginal agroecoregions.

The Governing Board of the Institute recently approved the *policy of ICRISAT on Intellectual Property Rights and Code of Conduct for interaction with the Private Sector*. This document gives guiding principles for ICRISAT in IP management, exchange of genetic resources, and mechanisms regarding IP and protected material by recipients to ensure their use to assist the Institute in achieving its mission. The document also provides a code of conduct for interaction with the private sector. While dealing with the private sector and other research-for-development partners, ICRISAT will act according to the *CGIAR Center Statements on Genetic Resources, Intellectual Property Rights, and Biotechnology* jointly approved by the Center Directors and Center Board Chairs of the CGIAR, and which include the *CGIAR's Ethical Principles Relating to Genetic Resources and the Guiding Principles for the CGIAR Centers on IP and Genetic Resources*. I would encourage all of you to get a copy for your reference.

This workshop is an opportunity to share different perspectives. We have a strong panel of speakers from the private industry, not only the seed industry, but also vertically integrated agro-industrial enterprise with strong R&D capacity (the sugar industry) as well as from the health biotechnology sector (hepatitis vaccine production). The experiences of these organizations and their perspectives on future collaboration with the public sector will provide valuable insights. Equally, participants are drawn from both the private sectors as well as from the public sector research community.

Discussion of these issues is important. Fresh insights will contribute to building more productive public-private sector interaction at ICRISAT. This will underpin our continuing efforts to make science count for the world's poorest and because our joint efforts with you resonates a *Science with a Human Face*.

Thank you.

Strengthening India-ICRISAT Strategic Partnership in Sorghum Research

Speech Delivered during the Group Meeting of the All India Coordinated Sorghum Improvement Project, 5 May 2001, CRIDA, Santoshnagar, Hyderabad, Andhra Pradesh, India

Distinguished guests, colleagues from the science community, friends, ladies and gentlemen, good morning.

Thank you for inviting me to the 31st annual meeting of the All India Coordinated Sorghum Improvement Project. It gives me immense pleasure to be with you in exchanging experiences on sorghum improvement in India. Although you must have had a hectic schedule yesterday, I am confident that your deliberations today and tomorrow will help you look into the immediate future of sorghum improvement in this country. This is very important, especially within the context of the WTO/GATT agreement and other global changes occurring around us in general, and in the cropping systems and utilization of sorghum in particular.

As you are well aware, sorghum is one of our five mandate crops at ICRISAT. It is the fifth most important cereal crop grown in the semi-arid regions of the world. ICRISAT holds about 36,000 accessions of this crop in trust under the FAO-CGIAR agreement. These germplasm accessions have been systematically characterized to maintain and distinguish their identity, and to enhance their utilization.

At this point, let me mention briefly the strategic directions of CGIAR, ICRISAT, and sorghum research. The CGIAR envisions a food-secure world for all. Its mission is to achieve sustainable food security and reduce poverty in developing countries through research for development. Research is carried out by adapting and applying modern scientific tools to help solve the problems of the poor.

We at ICRISAT considered this vision and mission in finalizing our medium term plan for 2002-2004. ICRISAT's vision is *Science with a Human Face.* This means that we conduct research not for its own sake

but for improving the well-being of the people in the semi-arid tropics. Specifically, this requires us to tailor our research programs to address and resolve real human needs: to reduce poverty, hunger, and environmental degradation across the dry tropics of the world.

On the other hand, our mission is to help developing countries apply science to increase agricultural productivity and food security, reduce poverty, and protect the environment. In terms of sorghum, we want to help achieve higher farm productivity and sustainability by genetically improving cultivars together with other mandate crops and developing appropriate technologies for them.

We pursue our vision and mission in close partnership with NARS, advanced research institutions, civil society organizations, and the private sector.

Here in India, we are therefore very fortunate to collaborate with scientists from ICAR and the universities in several areas of sorghum research. Allow me to mention them specifically. These are: (1) mechanisms and molecular markers for resistance to various biotic stresses, and (2) development of seed parents and restorers tolerant to rainy and postrainy seasons in India.

Over the last five years, developments in national and international law have significantly changed the policy environment on the management and control of genetic resources. After the creation of the *Convention on Biological Diversity* (CBD) which recognizes the sovereign rights of nations over their genetic resources, ICRISAT placed its germplasm collections under the auspices of the FAO through an agreement signed in October 1994. This was done to ensure a relatively unrestricted and bilateral flow of germplasm to all countries.

In relation to the CBD and intellectual property rights, we at ICRISAT developed data bases on pedigrees and put them on our web page. We did this to help ensure transparency and give due credit to concerned sectors whenever the seed is dispatched. Moreover, it also facilitates the development of clear policy guidelines in acquiring germplasm and seed dispatch. In doing this, we consulted ICAR and university scientists.

In terms of impact, we are pleased to report that during the last 28 years, sorghum production per unit area in India increased to 143% from 0.46 to 0.8 t ha^{-1} resulting in increased sorghum production. This was achieved in spite of the reduced area for sorghum from 15 to 11 million ha during practically the same period. This is a breakthrough

that our close partnership has helped bring about. This is ICAR-Universities-ICRISAT partnership at its best!

While increased sorghum productivity should be primarily credited to our farmers, we as scientists can also share part of this achievement. Here in India, ICAR with its institutes and the universities, and ICRISAT scientists have worked hand in hand to improve sorghum cultivars not only for high grain yields but also for resistance to shoot fly, midge, foliar diseases, and Striga.

The cornerstone for our successful partnership has been the mutual sharing of ideas and materials. But above all the real factor is mutual trust.

ICRISAT helps produce a diverse range of materials useful to India and other places in the dry tropics. Indian programs help ICRISAT use their improved materials such as CSV 4, 555, UchV2, and 296B. On the other hand, Indian programs allow the use of hot-spot locations in India by ICRISAT scientists.

I am told that ICRISAT scientists used to work in places like Bhavanisagar in Tamil Nadu, Dharwad in Karnataka, Hisar in Haryana, and Warangal in Andhra Pradesh. Likewise we have strong partnerships in breeding for midge, Striga, and shoot fly resistance in Dharwad, Akola, Parbhani, and other places.

We at ICRISAT are therefore grateful to the sorghum research managers and scientists in India for their trust, comradeship, and generosity. Please join me then in congratulating our sorghum scientists who, through close partnership, have helped farmers attain higher productivity.

However, the funding situation in the entire CGIAR system has drastically changed in recent years. Core funds have generally decreased. Hence our scientists at ICRISAT are devoting their time to write special projects to attract funds for specifically targeted areas of research.

As a result ICRISAT is able to attract private sector funds for research in sorghum. We therefore thank the private sector who appreciate the need for further research in sorghum.

Private sector generosity is not only shown in sharing funds but also in not claiming any exclusive rights to our research products. I learned from Dr Belum Reddy that several public sector scientists

including those from the National Research Center for Sorghum have visited the nurseries and selected materials for use in their programs. We also thank Dr Rana and his colleagues in understanding the ICRISAT-private sector partnership and in foreseeing its benefit to the public sector.

In the past ICRISAT was hesitant to carry out research on grain quality, which was considered a priority on the Indian agenda. The reasons were: (1) ICRISAT did not have enough qualified people, and (2) we had no comparative advantage compared to private sector in this area. Nevertheless, ICRISAT has accommodated priority areas of the Indian program in its core agenda. I cite here two examples, namely shoot fly and grain mold resistance breeding.

ICRISAT is also working in strategic partnership with sorghum scientists in India in the area of new science – genetic transformation, molecular markers, diversity analyses, and comparative mapping. Likewise, scientists at ICRISAT, ICAR, and universities are working together to develop special projects for additional funds.

A good and very recent example is the ADB grant for molecular markers for shoot fly resistance in sorghum. I learned that some of you had been to Vietnam to attend our work planning meeting. I trust that the said meeting achieved its planned outputs.

There are other examples of partnerships we have established in sorghum research. Unfortunately, time may not allow me to list them all.

Before I close I want to draw your attention to the challenges ahead of sorghum research. In brief, these are:

1. The demand for sorghum grain as food in India is decreasing and forage/fodder use and grain as poultry feed is increasing. How do we get additional resources to meet this?
2. Our major research achievements so far have been confined to rainy season sorghum. However, the productivity increase in postrainy season sorghum is almost negligible. What can we do about it?
3. New tools such as biotechnology, participatory breeding, and information technology are increasingly available. How can we use them in combination with traditional methods in sorghum research?
4. The world's food situation is relatively secure for the time being. If so, how do we address the issue of 'hidden hunger' caused by

imbalanced nutrition? How can we emphasize breeding for micronutrients, vitamin A, and other essential amino acids?

I am sure that you as a group can make use of the time available to address not only the immediate tasks of planning for next year, but also these bigger challenges mentioned.

Let us bear in mind that the science we do should ultimately impact on the poor and improve their health and well-being. Similarly sorghum research and development should go hand in hand to win our war against hunger and poverty in the dry tropics. This is an important effort to accelerate the *Grey-to-Green Revolution* in these areas.

Through our strategic and close partnership, I'm sure we will win this war.

I thank the ICAR, university authorities, in particular Dr RS Paroda, Dr Mangala Rai, Dr BS Rana, and Dr IV Subba Rao for giving me this opportunity of sharing my ideas with you today.

Let us work further to improve this crop, which is cultivated by poor farmers in 43 million ha under harsh environments in this country and across the globe.

Thank you and good morning.

Speech by Dr William Dar on the Occasion of the Signing of the Memorandum of Understanding between the Government of Mozambique and ICRISAT

15 May 2001, Maputo, Mozambique

Main dignitaries Hon. Helder Muteia, the Hon. Minister of Agriculture and Rural Development; Tomas Beruardino, Permanent Secretary, Ministry of Agriculture; and Rural Development, Mission Director, USAID - Mozambique, Rafael Uaiene, Director, Instituto de Investigacao Agronomica; Dr. Pedro Sanchez, Director General, ICRAF; your Excellencies, and distinguished guests.

Large parts of Mozambique can be classified as semi-arid, and so it is somewhat ironic that global attention has been focused on the country because of flooding when drought is a greater long-term threat to livelihoods of farmers in these areas.

ICRISAT researchers have been collaborating with our counterparts in Mozambique for more than two decades. Sorghum, millet, groundnut, and pigeonpea are all grown in the country, and Mozambique produces more groundnuts than the rest of the SADC Region put together. The country is also re-emerging as a major pigeonpea exporter, and the institute sees the market-driven approach that is being applied to the pigeonpea subsector in Mozambique as highly innovative. We understand that significant commercial investments are being made that will result in the country being able to export processed pigeonpeas in addition to the raw product, as is the case now.

The development of these crops has been constrained both in Mozambique and elsewhere in the region because of problems with seed supply. As a result, one of the ICRISAT centerwide projects is looking at *Improving Seed Supply for Research Impact*. This project has three components: commercial seed supply, relief seed supply, and the provision of breeder and foundation seed (source seed). Relief seed has been included as a specific component in recognition of the large sums of money that are spent by humanitarian agencies on seeds in times of disaster.

Our research on the impact of relief seed distributions in many countries, including Somalia, South Sudan, North Uganda, Angola, and Kenya, is showing that farmer seed systems are very resilient and even in times of extreme stress are largely able to provide farmers with seed of the crops and varieties that they prefer. Mozambique has been one of the major recipients of relief seed on the continent, but many stakeholders are now recognising that continued relief seed distributions might be inhibiting the development of more sustainable seed delivery mechanisms.

It is a great honor to be invited by the Government of Mozambique to review the issues related to relief seed and to develop seed assessment tools that can be applied in times of emergency. The support of USAID/Mozambique in this venture is gratefully acknowledged. We would like to give special thanks to Rafael Uaiene, Director INIA, and to Christine de Voest and Gale Rozell of USAID/ Mozambique, for all their help and encouragement to ICRISAT.

ICRISAT, together with its sister international research centers, is about applying *Science with a Human Face* in fighting poverty. We are strongly committed to strengthening our existing collaboration with sister centres in this endeavor. ICRAF and ICRISAT already share resources in Nairobi, where ICRAF hosts ICRISAT, and in Mali where ICRISAT hosts ICRAF. This process will now be extended to Mozambique where we join another of our sister centers IITA.

Last but not least, let me again highlight the strategy that we are pursuing with our partners in enhancing the productivity of the dry tropics, where we are helping the farmers adapt their crops and production systems to the environment. It is beyond the means of the resource-poor farmers of the dry tropics if they adapt the environment to the crops. So by making more efficient use of what they have, they can turn these grey areas green. The Government of Mozambique is one key partner together with the rest of our donors in turning adversities to opportunities, thereby making the *Grey-to-Green Revolution* a reality for the dry topics of sub-Saharan Africa.

Thank you (Gracias).

Integrated Watershed Development for the Tribal Areas of Adilabad

Inaugural Speech for the Training Course on Integrated Watershed Management for Agricultural Officials of ITDA, Utnoor, Adilabad District, 29-31 May 2001, ICRISAT, Patancheru, Andhra Pradesh, India.

Mr Vinod Agarwal, Commissioner for Tribal Development; Mr Navin Mittal, Project Officer of the Integrated Tribal Development Agency (ITDA) in Utnoor, Adilabad district; the Agricultural Officers and Area Development Coordinators of ITDA in Utnoor, colleagues from ICRISAT, ladies and gentlemen, good morning.

As some of you may already know, ICRISAT and ITDA have joined hands through a Memorandum of Agreement to pursue the noble mission of reducing poverty in the semi-arid tropics. This early, I would like to mention that integrated watershed management is one of the keys to improving farm productivity and reducing poverty in the semi-arid tropics. Towards this end ITDA and ICRISAT are working together to reduce poverty and increase farm productivity through the efficient management of natural resources.

To bring this about, my colleagues at ICRISAT led by Dr SP Wani have organized this training course to update you on the knowledge and skills of efficient watershed management. After this course, they will also be working with you in Adilabad district. Many of you have probably not seen ICRISAT before this course. I therefore appreciate the efforts of Mr Navin Mittal, the Program Officer of Adilabad who has arranged this training visit for you.

ICRISAT is the International Crops Research Institute for the Semi-Arid Tropics. ICRISAT is about people: poor men, women, and children, struggling one day at a time to make ends meet. ICRISAT's vision is *Science with a Human Face*. We pursue this by tailoring research to address and resolve real human needs: to reduce poverty, hunger, and environmental degradation across the semi-

arid tropics of the world. Our mission is to help developing countries like India apply science to increase agricultural productivity and food security, reduce poverty, and protect the environment.

The semi-arid tropics are home to 350 million poor people who are not able to fulfill their daily dietary needs. Likewise, the semi-arid tropics have a harsh environment with very low rainfall and hot temperatures. The soils are not basically fertile and are prone to severe erosion and degradation.

You who are working closely with the tribal people must be aware of their practice of cutting the forest to cultivate the land for food crops. However, the forest areas are already depleted. In fact, in most developing countries, even marginal lands are being cultivated for food.

In the Adilabad district where you are working, 18% of the population are tribal. Earlier, their area was well forested. However, the burgeoning population has forced them to cultivate even the marginal areas for food. This ended the natural system of long fallows which the tribal people traditionally practiced.

The region where you are working is endowed with good quality black soils called black cotton soils. This region receives 1,140 mm of rainfall every year. However, only one crop is grown during the year. Farm incomes are therefore very low, and the bulk of the population in the district lives in poverty. Moreover, the depletion of the forest cover makes the fertile soils prone to degradation.

Within this context, the ITDA in Adilabad is working to reduce poverty of the tribal people through integrated rural development. I am very happy that dynamic project officers such as Mr Mittal are applying science to rural development in the region. They do this by sharing improved technologies from research organizations like ICRISAT with farmers through change agents like you.

The natural resources in your district need to be nurtured and taken care of properly. The most critical resources are water and soil. If

these resources are managed properly, even rainfed areas can be as productive as irrigated areas. On the other hand, if water is not managed properly, even with good rainfall, soils are degraded and drinking water becomes unsatisfactory.

In effective water management, the most appropriate land unit is the watershed. At ICRISAT, we have evaluated the integrated watershed management approach for the last 25 years for rainfed areas. Our results show that in Patancheru, deep black soils could grow two crops during rainy and postrainy seasons. We also produced an average of 4.7 t of sorghum-pigeonpea or maize-chickpea per ha. This approach also improved soil quality.

Likewise, our findings at ICRISAT show that through effective watershed management, we can use 65% of rainfall for crop production. If this is not done, only 30% of rainfall can be used. This means that we can double the usage of available water through effective watershed management in the rainfed areas.

Through improved watershed management, soil loss is also reduced from 6.4 t to only 1.5 t ha^{-1}. Using this approach we have profitably grown different crops such as soybean, sunflower, sorghum, maize, cotton, pigeonpea, chickpea, groundnut, and other crops under rainfed conditions.

Furthermore, this approach is also being evaluated in on-farm watersheds in other parts of India, Thailand, and Vietnam. One of the on-farm watersheds in India is at Kothapally here in Andhra Pradesh. Farmers in Kothapally are very happy with the watershed management activities done during the last two years. They have harvested up to 4.2 t ha^{-1} maize and pigeonpea, and their well water levels have improved. They are also using less pesticides and trying new methods of preparing compost from farm residues.

I am therefore very happy that ITDA has decided to apply the Kothapally model of watershed management to other areas in

Adilabad. You are the key agents who will make this happen. You are the bridge between research institutions like ICRISAT and our knowledge-starved tribal people in Adilabad. In the end, I'm confident that your efforts will be rewarded as we achieve the mission of reducing poverty among our tribal people in the district.

This training program will expose you to the work we have done at ICRISAT together with farmers who are our main partners. I therefore wish that during your stay here, you will interact with our scientists and internalize learnings on effective watershed management.

Henceforth, let us join hands together to make watershed management most productive and beneficial in increasing the incomes of poor tribal farmers in Adilabad.

I would like to see that day when watershed management will become the major vehicle in reducing poverty among our tribal people. Development agencies such as ITDA should therefore cultivate and sustain close linkages with us. This way our research findings can be directly shared with poor farmers to increase their incomes and protect the natural resource base.

This is the seed of the *Grey-to-Green Revolution* which we at ICRISAT are catalyzing to improve the condition of our poor people in the dry and marginal areas. I hope that everyone here today will be involved in this gigantic effort. Together, we can make this happen for our present and future generations.

I wish you all the luck and I hope you will enjoy the training course and your stay at ICRISAT.

Thank you and good morning.

Partnerships for Development: Setting Priorities for Agricultural Research in South and West Asia

Welcome Remarks during the APAARI meeting on Agricultural Research Prioritization for the South and West Asia Region, 5-7 July 2001, ICRISAT, Patancheru, Andhra Pradesh, India

On behalf of ICRISAT, allow me to welcome you to this meeting on agricultural research prioritization for South and West Asia. I hope that you had a safe and comfortable travel on your way to this very important meeting. As an important partner of APAARI, we are very pleased to host this three-day activity.

More than three months ago, as part of the process, we had the honor of hosting another APAARI meeting here in Patancheru, the First South Asia Regional Integration Meeting. Thirteen CG Centers and three affiliated centers were involved including TAC. During this meeting, we identified regional issues and challenges, eco-geographical targets, and the next steps in priority setting.

During APAARI's last General Assembly in November 2000, it was decided that agricultural research for the South and West Asia region should be prioritized. We also endorsed the regional partnership approach involving the NARS and other stakeholders in research prioritization and planning. Aside from preventing duplication, this will certainly facilitate research coordination in the region.

In this meeting, we will discuss the economic significance of various national production systems and commodities, including the constraints and opportunities that affect these systems, current thrusts of national agricultural research, and emerging research priorities in the region. These will be very important inputs to our joint APAARI-NARS-IARCs meeting in November 2001 when we will identify our global research agenda and collaborative research activities.

Our meeting is indeed very timely in the context of changes being pursued by the CGIAR. During ICW 2000, the CGIAR adopted a regional approach to research planning, priority setting, and

implementation. This was done to address the heterogeneous causes of poverty and food insecurity in different regions. It will also allow the integration of regional and global research priorities. For the CGIAR, this means seeking complementary gains that it could not achieve exclusively through a global or ecoregional approach.

At the recent MTM 2001 in Durban, the Change Design and Management Team spelled out the need to increase inclusiveness in agenda-setting at both global and regional levels. This will be done by interacting effectively with the Global Forum for Agricultural Research, regional organizations like APAARI, NARS, civil organizations, and the private sector. The CGIAR's emphasis on a bottom-up and regional approach to research planning and priority-setting certainly needs the input of APAARI. Likewise, the open book approach to establishing priority areas for Global Challenge Programs provides opportunities for APAARI to influence the CGIAR research agenda.

At the ground level, partnerships will become increasingly more important as the CGIAR adopts a programmatic approach to research planning. This will require increasingly close liaison with APAARI, sub-regional research organizations, and NARS. Moreover, the design and implementation of Global Challenge Programs will strengthen the role and capabilities of NARS.

During our recent midyear research review, ICRISAT has drafted guidelines in identifying and prioritizing our research themes. Although these are still being refined, these include:

1. Measurable impacts on poverty, food insecurity, and the environment.
2. Interdisciplinary approaches to integrated gene and natural resources management.
3. Problem-based and impact-driven research thrusts.
4. Comparative and competitive advantages across locations.
5. Collaborative advantages in enhancing opportunities for strategic regional partnerships.
6. High probability of success.
7. Building into existing institutional strengths.
8. High funding potential.

But as we go about setting our regional research priorities, let's not forget the more than 500 million poor people who live in this region.

Without diminishing in any way the importance of assistance to sub-Saharan Africa, it is worth noting that the number of poor people in the subregions of eastern India, Bangladesh, and Nepal is greater than that of sub-Saharan Africa! *Our greatest challenge therefore is still the reduction of poverty right here in Asia*.

Let us then put our heads together to formulate a strategy of how best to contribute to reducing poverty in South and West Asia through agricultural research. Furthermore, let us also map out how agricultural research can help the poor cope with the emerging challenges we have already identified: globalization, water scarcity, environmental degradation, poor seed systems, pesticide abuse, and malnutrition.

With this in mind, let me share with you ICRISAT's approach to poverty alleviation in the dry tropics. We are going about this through the *Grey-to-Green Revolution*. Most of us are familiar with the Green Revolution of the '60s and '70s. Undisputedly, it had tremendous impact in increasing farm productivity. Without it, a billion people would be hungry today.

However, the idea that the food problem has been solved by the Green Revolution is incorrect. It is sobering to realize that a quarter of the world's people missed the benefits of the Green Revolution. About 840 million people, 13% of the global population, are still food insecure. They are concentrated in developing countries led by South Asia (48%), followed by sub-Saharan Africa (35%), and Latin America (17%).

Many people ask us if it is possible to turn grey areas to green. Well, it's not easy. The grey areas are characterized by harsh, marginal environments, yearly climate variation, high risks, and scarce capital for the poor. But the good news is that the *Grey-to-Green Revolution* is overcoming these adversities. The key is to adapt cropping systems to the natural variability of the environment, not the other way around. Adapting the crop to the environment means farmers get more out of their own natural resource endowment. This approach also helps position them in the global market.

In the *Grey-to-Green Revolution*, we help empower the poor to manage their local resources and put them to much better use. By managing and optimizing local resources, poor people can turn adversity into opportunity. This way, they extricate themselves out of poverty on their own without dependence on costly inputs or external aid.

The *Grey-to-Green Revolution* is therefore about more than just increasing crop productivity. It's about empowering them to build their own capacities, self-confidence, and self-reliance.

In short, the Grey-to-Green Revolution is science with a human face.

At this juncture let me commend APAARI for its impressive achievements in strengthening the region's partnerships in agricultural research. Under the stewardship of our good friend, Dr. Raj Paroda, APAARI has gone a long, long way in leading and institutionalizing the regionalization of agricultural research.

Moreover, let me also congratulate APAARI in mapping out its vision towards 2025 focused on promoting strong partnerships in agricultural research in the Asia-Pacific region. ICRISAT sees APAARI as a close partner in helping alleviate poverty in the region. Our partnership seeks to enhance research coordination, foster information, share technology, and advocate policies to regional governments.

Before I close, let me reiterate that beyond producing quality and cutting edge technologies, our research priorities must focus on those who are the most marginalized, disadvantaged, and hungry. This is the human face of science. It must remain the overarching theme of our efforts and the paramount motive of our endeavors as our minds converge during this three-day meeting.

Thank you, and once again, my heartiest welcome to you all.

Science with a Human Face

Speech Delivered at the 73rd Foundation Course for Agricultural Research Service, 10 July 2001, National Academy of Agricultural Research Management, Rajendranagar, Hyderabad, Andhra Pradesh, India

First of all, let me thank the National Academy of Agricultural Research Management through its Director, Dr Katyal, for inviting me to speak before you on this 73rd Foundation Course for Agricultural Research Service. I have been informed that this course is attended by newly recruited scientists from various disciplines in India. I also understand that this course will orient you with the global and national scenario of agricultural research, equip you with a critical and holistic approach to planning, and sharpen your knowledge, skills, and attitudes in research management.

I am pleased to note that the Academy and ICRISAT share the same vision towards greater relevance, efficiency, effectiveness, and teamwork in conducting agricultural research. More than this, I am very happy to share with you our paramount vision of doing *Science with a Human Face*.

When I assumed office at ICRISAT in January 2000 I realized, having come from a farming family, that we needed a battle cry in our mission to help the poor of the semi-arid tropics. I felt strongly that there must be an overriding reason, a more encompassing objective behind the seemingly faceless science that we do. This is because ICRISAT does not deal only with crops in the semi-arid tropics. It helps the poor of the dry tropics – the men, women and children who struggle every day to make both ends meet.

That is why we decided to add a human dimension to our research programs and activities. To do this, we adopted *Science with a Human Face* as the guiding light for all our endeavors at the Institute.

ICRISAT is an organization that serves poor people first and foremost. Science is a means that we use to serve the poor, not an end in itself. If we do excellent research but if we do not make an

impact in improving the lives of the poor, we have failed. Only by using science to help developing countries reduce poverty, malnutrition, and environmental degradation can we say that we have made a difference.

Beyond producing quality and cutting edge science, our work at ICRISAT in cooperation with our partners should benefit the most marginalized, disadvantaged, and hungry. In other words, we tailor our research programs to meet real human needs.

The agricultural research we undertake does not only generate better knowledge about crop genes, production systems, and natural resource management. It also results in increased incomes for farmers and improved quality of life among farm households in the semi-arid tropics.

This is the human face of the science and the agricultural research that we do. This is the overarching theme of our efforts and paramount motive of our endeavors. This is the vision that we at ICRISAT would like to share with upcoming scientists and managers like you today.

Why should we do all of this? The single reason is poverty. In spite of the much heralded gains of science in increasing food production, there are still about 840 million people, 13% of the global population, who are poor and food insecure. They are concentrated in developing countries, led by Asia with almost half of its total population still food-insecure, followed by sub-Saharan Africa (35%), and Latin America (17%). In India, about 84% of the rural poor live in rainfed areas where food is very scarce.

To respond to the foregoing challenge, we have woven *Science with a Human Face* into our mission and Medium Term Plan for 2001 to 2003. ICRISAT's new mission is to help the poor of the semi-arid tropics increase crop productivity and food security, reduce poverty, and effectively manage the farm environment through impact-based research and *Science with a Human Face*. To put this into motion, we mapped out two goals in our Medium Term Plan, which are to:

1. Make crops in the semi-arid tropics more productive, nutritious, affordable, and accessible to the poor.
2. Develop tools and techniques for the sustainable utilization of natural resources in the semi-arid tropics.

In order to pursue these goals, we are implementing ten projects.

First is raising soil productivity to help farmers grow their way out of poverty. Our goal here is to develop integrated soil, water, and nutrient management options to raise system productivity, increase the adaptive capacity of ecosystems, and enable rural households to face risk and change.

Second is the efficient management of natural resources in watersheds. Through this project we aim to increase and improve rural livelihoods through better management of natural resources in agricultural watersheds.

Third is integrated pest management aimed at reducing environmental hazards through eco-friendly pest and disease management technologies.

Fourth is saving and utilizing biodiversity so as to secure and conserve the genetic diversity of crops in the semi-arid tropics.

Fifth is biotechnology. This aims to apply biotechnology so that it enhances the efficiency, effectiveness, speed, and precision of plant breeding.

Sixth is genetic diversification and enhancement. Our goal here is to diversify the genes of improved germplasm and cultivars with high and stable yield, acceptable quality, and resistance to biotic and abiotic stresses.

Seventh is improving seed supply to make seeds available and affordable to farmers.

Eighth is enhancing the impact of agricultural research in the semi-arid tropics by improving the efficiency of agricultural research systems and their policy environment.

Ninth is linking increased productivity with poverty reduction by providing an analytical basis in prioritizing investments in technology development to optimize impact.

Tenth is knowledge sharing by optimizing information flows between ICRISAT and its stakeholders.

Aside from our projects we also enunciated guiding principles to be followed by management and staff in pursuing *Science with a Human Face* at ICRISAT. Let me share some of these with you:

1. Embracing *Science with a Human Face* requires a paradigm shift in attitudes and behavior towards customers, stakeholders, and staff. Business as usual cannot continue.
2. ICRISAT's survival and growth depend on retaining and building up relevant competencies. New blood has to be brought in, supported by staff development.
3. New reward mechanisms based on performance will be introduced.
4. Revenue generation, public awareness, and service orientation will be strengthened by including full cost recovery mechanisms.
5. Business processes have to be improved both in research and management to improve effectiveness and cost savings.

Complementing *Science with a Human Face*, we are also spearheading a *Grey-to-Green Revolution* in the semi-arid tropics. You may be wondering what a *Grey-to-Green Revolution* means. Most of us are familiar with the Green Revolution of the '60s and '70s. It undisputedly had tremendous impact in increasing farm productivity. Without it, a billion people would be hungry today.

However, the idea that the food problem has been solved by the Green Revolution is incorrect. It is sobering to realize that a quarter of the world's people missed the benefits of the Green Revolution.

Many people ask us if it is possible to turn grey areas to green. Well, it's not easy. The grey areas are characterized by harsh, marginal environments, yearly climate variation, high risks, and scarce capital for the poor. But the good news is that the *Grey-to-Green Revolution* is overcoming these adversities. The key is to adapt cropping systems to the natural variability of the environment, not the other way around. Adapting the crop to the environment means farmers get more out of their own natural resource endowment. This approach also helps position them in the global market.

In the *Grey-to-Green Revolution*, we help empower the poor to manage their local resources and put them to much better use. By managing and optimizing local resources, poor people can turn adversity into opportunity. This way they extricate themselves from poverty on their own, without depending on costly inputs or external aid.

The *Grey-to-Green Revolution* is therefore about more than just increasing crop productivity. It's about empowering the poor to build

their own capacities, self-confidence, and self-reliance.

In short, the Grey-to-Green Revolution is science with a human face.

As I close let me challenge you, as promising scientists and managers of this great country, to do *Science with a Human Face* with us working together and spearhead the *Grey-to-Green Revolution* in the dry areas of India. Rather than allowing the adversities in these regions to daunt us, let us instead transform them into opportunities through quality science.

If we are to realize our vision for the poor and the hungry, if we are to succeed in making science relevant, effective, and efficient in this country, let us do it with a human face!

Thank you and good day.

Managing Gender and Diversity in the Workplace

Message During the Closing Program of the Women's Leadership and Management Course, 13 July 2001, ICRISAT, Patancheru, Andhra Pradesh, India

Ms. Vicki Wilde, our trainers, Ms. Dee Hahn-Rollins, Joni Herman, Pam Foster, participants, colleagues at ICRISAT, good afternoon.

On behalf of ICRISAT, let me thank Vicki for having chosen ICRISAT as the venue of this important course on women's leadership and management. We are really very pleased to have hosted this course involving women participants from CGIAR centers, FAO, GFAR, NARS, and ICRISAT. I have been informed that this is the sixth batch for this course and I have learned that most of you have found its content and methodology very useful.

As you may already know, the primary purpose of this course has been to enhance your leadership capacity and managerial effectiveness as women scientists and professionals. The major skills you have learned revolve around sustaining team performance, managing conflict, and building alliances, with gender as the overarching theme.

As a research leader myself, I fully appreciate the importance of gender and diversity in the workplace. In management one of our biggest challenges involves building trust and cooperation among our constituents. For us to achieve this, we must understand the diversities existing in the organization. A researcher once said, "gender affects everything we do, the way we look at the world, how we operate, and the way we make sense of absolutely everything in life." Being fellow leaders and managers, I'm sure you fully agree on the similarities and differences in men's and women's perspectives. Research has found that men and women are more alike in personality characteristics such as independence and dependence, and individual abilities such as mathematical and verbal skills.

However, research has also documented two basic differences. Women often establish their identity through affirmation and cooperation with others. Men often establish their identity through competition and dominance. Women often ask or request an action or behavior, whereas men influence others by using direct commands.

As managers, we must understand these differences to make men and women work together closely in the organization. This is especially significant as we recognize the roles and relationships among men and women in a social, political, economic, and cultural context. Due to this, they bring varied perspectives and approaches to the workplace. For us to achieve results we must manage this diversity of perspectives.

Sound management of gender and diversity strengthens organizational performance. Recent research shows that organizations with a diverse workforce have more creativity and innovation, stronger intellectual vitality, enhanced organizational learning, and improved partnerships. They also respond rapidly and successfully to changes in their environment.

Since I noticed that all participants in this course are women, let me share with you how women make a difference in the dry tropics. You may not know it, but women produce 80% of the food in sub-Saharan Africa, and 60% here in Asia. ICRISAT develops technologies that especially benefit women, to promote greater social equity, and to accelerate agricultural development.

In Africa groundnut is known as a women's crop. Grown by them around the house, it is a vital source of income and nutritious food for the family. In Zimbabwe women farmers are helping ICRISAT researchers share new water conservation and crop management techniques. They are also pioneering as millet seed producers and marketers, helping solve the problem of seed supply in the country. In Namibia a woman named Maria Kaherero was involved in selecting the 'Okashana 1' millet variety which was released in 1989. In Kenya women are actively promoting improved pigeonpea varieties after our researchers showed them its potential as a food and cash crop.

In Maharashtra, India, we reduced the labor burden of women by making weeding and harvesting easier. Similarly, in Barind, Bangladesh, women earned money from selling young chickpea leaves which were high-value vegetables in the market.

From these experiences, it is clear that our efforts involving women bring about hope in the dry tropics. And hope is the fire that feeds the

Grey-to-Green Revolution. You may wonder what the *Grey-to-Green Revolution* is all about. Most of us are familiar with the Green Revolution of the '60s and '70s. However, let us note that a quarter of the world's people missed the benefits of the Green Revolution. About 840 million people, or 13% of the global population, are still food insecure. Most of them are in the dry tropics. Sometimes we think of the dry tropics as lacking in resources and beyond hope. The good news is that the *Grey-to-Green Revolution* is overcoming these adversities.

The key to this is adapting cropping systems to the natural variability of the environment, not the other way around. By unleashing the power and ingenuity of women to turn the grey tropics green, ICRISAT and its partners are not only improving the livelihoods of today's generation. We are also seeding the *Grey-to-Green Revolution* for the future.

Let me then recognize the efforts of CGIAR's Gender and Diversity Program led by our friend, Vicki Wilde. Established in 1998 out of the CGIAR Gender Staffing Program, this initiative has been helping CGIAR centers attract and retain highly qualified women scientists and professionals. It has also helped create work environments supporting the productivity, career development, and job satisfaction of men and women in the CGIAR.

Through this course, we are confident that your leadership and management skills have been honed to face new and bigger challenges in your respective organizations. We also hope that this course will foster closer collaboration, open dialogue, and better appreciation of the different contributions that men and women bring to your workplace.

Thank you. I hope you enjoyed your stay at ICRISAT.

Grey-to-Green Revolution through Science with a Human Face

Speech Delivered at the Indian Agricultural Research Institute (IARI), 20 July 2001, New Delhi, India.

First of all, let me thank the Indian Agricultural Research Institute for inviting me to speak before you today. It gives me great pleasure to be with scientists like you as it provides me the opportunity to share ICRISAT's vision and mission for the poor people of the dry tropics.

When I assumed office at ICRISAT in January 2000, I realized, having come from a farming family, that we needed a battle cry in our mission to help the poor of the dry tropics. I felt strongly that there must be an overriding reason, a more encompassing objective behind the seemingly faceless science that we do. This is because ICRISAT deals not only with crops in the dry tropics. It also helps the poor – the men, women, and children who struggle every day to make both ends meet.

Therefore, we decided to add a human dimension to our research programs and activities. To do this, we adopted *Science with a Human Face* as the guiding *mantra* for all our endeavors at the Institute.

ICRISAT is an organization that serves poor people first and foremost both in Asia and sub-Saharan Africa. Science is a means that we use to serve the poor, not an end in itself. Even if we do excellent research and make no impact in improving the lives of the poor, we have failed. Only by using science to help developing countries reduce poverty, malnutrition, and environmental degradation can we say that we have made a big difference.

Beyond producing quality and cutting edge science, our work at ICRISAT in cooperation with our partners, should benefit the most marginalized, disadvantaged, and hungry. In other words, we tailor our research programs to meet real human needs.

The agricultural research we undertake not only generates knowledge about genetic resources, production systems, and natural resource management; it also results in increased incomes for farmers and improved quality of life among farming households in the semi-arid tropics.

This is the human face of the science and agricultural research that we do. This is the overarching theme of our efforts, the paramount motive of our endeavors. This is the vision that we at ICRISAT would like to share with you today.

Why should we do all of this? The single reason is poverty. In spite of the much heralded gains of science in increasing food production, there are still about 840 million people, 13% of the global population, who are poor and food insecure. They are concentrated in developing countries, led by Asia with almost half of its total population still food-insecure, followed by sub-Saharan Africa (35%), and Latin America (17%). Here in India, about 840 million people live in rainfed areas where food is very scarce.

To respond to the foregoing challenge, we have woven *Science with a Human Face* into our mission and Medium Term Plan for 2001 to 2003. ICRISAT's new mission is "to help the poor of the semi-arid tropics increase agricultural productivity and food security, reduce poverty, and effectively manage the farm environment through impact-based research and *Science with a Human Face*." Similarly, we have integrated *Science with a Human Face* with our core values which are excellence, relevance, openness, partnership, and serving with a sense of urgency.

To put these into motion, we mapped out two goals in our Medium Term Plan which are to:

1. make crops in the semi-arid tropics more productive, nutritious, affordable, and accessible to the poor.
2. develop tools and techniques for the sustainable utilization of natural resources in the semi-arid tropics.

In order to pursue these goals, we are implementing ten projects.

First is raising soil productivity to help farmers grow their way out of poverty. Our goal here is to develop integrated soil, water, and nutrient management options to raise system productivity, increase the adaptive capacity of ecosystems, and enable rural households to face risk and change.

Second is efficiently managing natural resources in watersheds. Through this project, we aim to increase and improve rural livelihoods through better management of natural resources in agricultural watersheds.

Third is reducing environmental hazards through eco-friendly integrated pest management technologies.

Fourth is saving and utilizing biodiversity so as to secure and conserve the genetic diversity of crops in the semi-arid tropics.

Fifth is biotechnology. This aims to apply biotechnology so that it enhances the efficiency, effectiveness, speed, and precision of plant breeding.

Sixth is genetic diversification and enhancement. Our goal here is to diversify the genes of improved germplasm and cultivars with high and stable yield, acceptable quality, and resistance to biotic and abiotic stresses.

Seventh is improving seed supply to make seeds available and affordable to farmers.

Eight is enhancing the impact of agricultural research in the semi-arid tropics by improving the efficiency of agricultural research systems and their policy environment.

Ninth is linking increased productivity with poverty reduction by providing an analytical basis in prioritizing investments in technology development to optimize impact.

Tenth is knowledge sharing by optimizing information flows between ICRISAT and its stakeholders.

In doing research, we recognize system diversification as the key to increasing livelihood and income opportunities in the dry areas. Aside from our projects, we also enunciated guiding principles to be followed by management and staff in pursuing *Science with a Human Face* at ICRISAT. Let me share some of these with you:

1. We have made a paradigm shift in our attitudes and behavior towards customers, stakeholders, and staff. Business as usual cannot continue.
2. Our survival and growth depend on retaining and building up

relevant competencies. New blood has been brought in supported by staff development.

3. New reward mechanisms based on performance are being introduced.
4. Revenue generation, public awareness, and service orientation are being strengthened, including full cost recovery.
5. Business processes are being improved in research and management to improve effectiveness and cost savings.

To promote *Science with a Human Face,* we are spearheading a *Grey-to-Green Revolution* in the dry tropics. You may be wondering what a *Grey-to-Green Revolution* means. Most of us are familiar with the Green Revolution of the '60s and '70s. It undisputedly had tremendous impact in increasing farm productivity. Without it a billion people would be hungry today.

It is worth mentioning that while the contributions of international agricultural research centers were crucial, I would like to emphasize that the *Green Revolution* would not have succeeded without the involvement of the national systems, civil society organizations, and the private sector.

In particular, we recognize Professor MS Swaminathan's role in India's Green Revolution. Nobel laureate Norman Borlaug himself praised India's national research system, acknowledging its responsibility for the wheat revolution in this country. Our Board Member Dr Raj Paroda, developed the Indian NARS as a model of the developing world in agricultural research.

It is true that Green Revolution cereals responded well to inputs such as good water management and fertilizer. Some worried that this benefited only richer farmers who could afford these inputs. However, studies in Punjab and the Philippines found that millions of small farmers also benefited. They were not forced out of their land or into poverty by richer farmers.

While favorable areas were able to fully optimize the *Green Revolution,* the dry areas were being left behind. Many worried about this inequity. The idea that the food problem has been solved by the *Green Revolution* was incorrect.

It is sobering to realize that a quarter of the world's people missed the benefits of the Green Revolution. How can these people remain hungry

in the midst of plenty? Simply because they are poor they cannot afford to buy their basic food needs.

So as the miracle of the *Green Revolution* became commonplace in the late 1970s, the world began to ask for even more. They began to ask us to create a similar miracle for those who had been bypassed, especially those who lived in the harsh, dry areas.

Hence, the need for a *Grey-to-Green Revolution.*

Many people ask us if it is possible to turn grey areas to green. The grey areas are characterized by marginal environments, yearly climate variation, high risks, and scarce capital for the poor. Our challenge was therefore to turn these adversities into opportunities. By doing *Science with a Human Face*, we are happy to share some milestones.

For example, our research on watersheds has shown that farmers can quadruple yields. This can be done simply by managing the rainfall better through proper soil tillage and soil cover, and by harvesting the water in the form of small, on-farm reservoirs.

Huge productivity gains could be made in the dry areas by genetically controlling major crop diseases such as fusarium wilt of pigeonpea. This was one of the first major impacts of ICRISAT, working hand in hand with government agencies in India.

When diseases of millet such as downy mildew are controlled, huge benefits are reaped by farmers. With our national partners in India, we have accomplished this too.

Similarly, with our partners we developed early-maturing, wilt-resistant chickpea varieties that extended cultivation further south into the hot, dry areas of central India. This gave farmers an alternative to tobacco and cotton, which were ruining them with high insecticide costs.

In sum, we can make the *Grey-to-Green Revolution* happen. The key is to adapt cropping systems to the natural variability of the environment, not the other way around. Higher productivity can be made by adapting the crop to the environment, through better stress, disease, and pest resistance or avoidance. Adapting the crop to the environment also means farmers get more out of their own natural resource endowment. This approach also helps position them in the global market.

In the *Grey-to-Green Revolution*, we help empower the poor to manage their local resources and put them to much better use. By managing and optimizing local resources, poor people can turn adversity into opportunity. This way, they extricate themselves from poverty on their own, without depending on costly inputs or external aid.

The *Grey-to-Green Revolution* is therefore about more than just increasing crop productivity. It's about empowering the poor to build their own capacities, self-confidence, and self-reliance.

In short, the *Grey-to-Green Revolution is science with a human face.*

And the *Grey-to-Green Revolution* is paying off. A study by the Asian Development Bank last year concluded that "Investments in infrastructure, agricultural technology and human capital are now at least as productive in many rainfed areas as in irrigated areas and have a much greater impact on poverty alleviation."

As I close, let me challenge you, the committed scientists of this great country, to do *Science with a Human Face.* Let us work together to spearhead the Grey-to-Green Revolution in the dry areas of India. Rather than allowing the adversities in these regions to daunt us, let us instead transform them into opportunities through quality science.

I also pose a challenge to the developed countries to make agriculture and agricultural research high-priority investment areas. This is also true for developing countries, and India is no exception.

If we are to realize our vision for the poor and the hungry, if we are to succeed in making science relevant, effective and efficient in this country, let us do it with a human face!

Thank you and good day.

Improving Natural Resource Management for Sustainable Rainfed Agriculture in Asia

Inaugural Address during the Training Workshop on Participatory On-Farm Research Methods, 26 July 2001, Bangkok, Thailand.

Dr Narongsak, DDG, Department of Agriculture; Director Preecha Chenychoom, Director, Office of Research and Development - Region 3, Thailand; officials from Khon Kaen University, Department of Land Development, Dr Amado Maglinao of the International Water Management Institute, participants from Thailand, India, Vietnam, and Indonesia, my colleagues from ICRISAT, good morning.

On behalf of ICRISAT, I am pleased to welcome all of you to this Training Workshop on Participatory On-Farm Research Methods. We are conducting this course in partnership with the Department of Agriculture of Thailand, Khon Kaen University, and our sister institute IWMI. This activity showcases our joint commitment of increasing the productivity and sustainability of rainfed areas in Asia. I therefore congratulate Drs Narongsak, Aran Patanthoi, and Wani for putting this course together.

All of you who are working in the dry land areas of Asia are well aware of the natural resource dilemma we are facing today. This is due to high demographic pressures and our dependency on land as a means of livelihood. With increasing population, more marginal lands are being cultivated.

In countries like Thailand and Vietnam, forestlands are also increasingly cultivated. About 700 million ha are rainfed with erratic rainfall. Additionally, irrigation is rarely assured in Asia.

Thus the major problems we face in Asia today are food insecurity, poverty, and environmental degradation, along with burgeoning population. In this region, 70% of the population depends on agriculture for a living, putting heavy pressure on the land. Poverty incidence is 28%. The population growth rate remains high,

compounded by scarce capital. As a result, poverty manifested through hunger, malnutrition, and poor health haunts both the people and the governments of Asia.

The major constraint to sustaining the productivity of Asian dry lands is land degradation. I have visited the benchmark watersheds in Vietnam and Thailand. Clear evidence of severe land degradation can be seen in these places. Torrential seasonal rainfall creates a high risk for the cultivated lands. In Thanh Ha watershed in Vietnam and Tad Fa watershed in Thailand, forest lands on steep hills have been cultivated, resulting in severe soil erosion.

In order to sustain the productivity of dry lands in Asia and minimize land degradation, the Asian Development Bank (ADB) is supporting ICRISAT efforts in *Improving Management of Natural Resources for Sustainable Rainfed Agriculture*. This is being implemented in partnership with the NARS of India, Thailand, and Vietnam. In this project led by Dr Wani, five on-farm benchmark watersheds are operational varying in size from 30 to 10,000 ha. All the on-farm watersheds are technically supported by a consortium of institutions to address the complex problems of sustaining productivity. Our project is unique because on-station research is linked to on-farm benchmark sites.

Now let me touch on a subject of personal importance to me. You have all heard of the Green Revolution. The benefits of the Green Revolution did not reach the millions of poor living in the grey rainfed dry areas. Development investors earlier realized that quick gains could be achieved through investments in favorable areas. However, recent findings by the International Food Policy Research Institute (IFPRI) reveal that investments in rural infrastructure, agricultural technology, and human capital in many rainfed areas have been as productive as in irrigated areas. They also have an enormous impact on poverty. The study concludes that increased investments in rainfed areas is a *win-win* proposition. The same findings of ADB were reported last year. With all these, we need now to spearhead and enhance the *Grey-to-Green Revolution* in rainfed dry areas through science with a human face.

However, unlike returns to agriculture in the irrigated areas, returns in rainfed areas are seldom immediate and therefore require stronger partnerships. That this project has gained excellent momentum is a credit to all of you, the key partners in the project. Managing five on-farm benchmark watersheds in three countries and conducting on-

farm participatory research is a daunting task, and you are to be commended for meeting this challenge.

To fill this tall order, we definitely need special skills. Recently, in Kenya ICRISAT underwent a one-week course on *Leading and Managing for Collaborative Advantage*. Dr Wani, who participated in this course, will tell you how important and difficult it is to manage partnerships and teams. I am delighted that the ADB has agreed to support this course on participatory research because this on-farm approach has been proven the most effective way of sharing technologies among farmers and researchers.

On-farm trials are different from on-station trials. We need special skills and precautions to conduct on-farm trials effectively. We must take maximum precautions in conducting them because the problems are complex. There is a vast difference between on-farm trials conducted by researchers and participatory on-farm trials. All of you involved in these on-farm participatory trials are aware of the importance of human resources in the dry land areas. If we have to transform these areas from grey to green, we must minimize environmental degradation.

To achieve this goal, we must put people first. This course, which will empower you to conduct participatory on-farm trials effectively, will help consolidate the gains we have already made. The next phase is to expand on-farm research so that technologies to conserve natural resources and increase productivity are evaluated and further fine-tuned by farmers.

In this project, you will be addressing the problems of the millions of resource-poor farmers in the dry tropics. This is our mission at ICRISAT and our core research agenda. I am confident that the team led by Dr Wani will take you through the course successfully and in the end, that you will be able to facilitate on-farm participatory research in your own locations.

Before I close, I would like to thank our friend and partner, Dr Narongsak and his team who organized this course in Thailand. Dr Rego has ably handled the logistical arrangements, and he is proving a good resource person in this project. Let me also commend the faculty of KKU who will share their expertise with you. I likewise thank Dr Aran Patanthoi, an old friend of ICRISAT who continues to help us in this project. I wish you all the best and look forward to seeing the results of your experience here.

Thank you and good day.

ICRISAT AND MSSRF: Partners on Food Security

Address During the Release of MSSRF Annual Report, 7 August 2001, Chennai, Tamil Nadu, India

I am very glad to have been invited to say a few words this morning in the congenial surroundings here at the MS Swaminathan Research Foundation. Let me join the rest in wishing the Father of the Green Revolution of India, Professor MS Swaminathan the best returns of the day and may you have more birthdays to come. My pleasure in appearing before you is twofold.

First, as Director General of ICRISAT, I am honored to have the opportunity to express my wholehearted support for the aims and values of this wonderful foundation, because your aims and values closely echo those of ICRISAT. This is of course no surprise, because Professor Swaminathan has been one of the foremost proponents of the CGIAR system since its inception. As the Director General of the Indian Council of Agricultural Research (ICAR) in 1972, the very year ICRISAT was founded, Professor Swaminathan became our first Governing Board Vice Chairman. Indeed, along with Dr CF Bentley, our first Chairman, and Dr Ralph W Cummings, our first Director, who sadly passed away last month, Professor Swaminathan was one of the three legs of the tripod upon which our Institute was built. He was there at the beginning and for the past 29 years he has continued to be a guiding force and a pillar of strength in support of our research agenda. So, for a combination of historical and professional reasons, I have the utmost respect and admiration for him and for this marvelous foundation.

But I am also particularly proud to be a part of this function because of a more personal connection between Professor Swaminathan and myself. This connection involves my native country, the Philippines. As most of you know, Professor Swaminathan served as the Director General of the International Rice Research Institute (IRRI), which has its headquarters in the Philippines during which time I got to know him because I worked with Benguet State University and later on with the Department of Agriculture.

The connection is even more interesting. Professor Swaminathan was the first Asian to serve as Director General of a CGIAR Center. While he did so I was with the government of the host country where he worked. Now our roles are reversed. I have become the second Asian to serve as DG of a CG Center and Professor Swaminathan is an illustrious citizen of my Center's host country – India.

The Swaminathan Foundation and ICRISAT have both similarities and differences. Let me mention some of the differences first. We at ICRISAT have a broad mandate that fills an important niche in the international agricultural research community – improvement of crop productivity in the semi-arid tropics. Within this general mandate we are able to emphasize or prioritize various research thrusts, but the mandate necessarily defines what we do. The Swaminathan Foundation on the other hand, is wholly autonomous in character, and thus free to choose its own agenda.

The Foundation started its work on two key issues: coastal systems research and food security. It has made a significant mark in both areas.

The coastal systems research program has led to the evolution of wholly new participatory techniques for wetland restoration on the coasts. Simultaneously, fundamental and applied research on the genetics of mangroves has been conducted and several publications in theoretical and applied genetics have been released. Salt tolerance has been induced in a model plant system using the genes derived from mangrove plants. This work is most impressive, and I salute the scientists of the Swaminathan Foundation for successfully combining scientific excellence with poverty alleviation.

The food security issue is one that we at ICRISAT share and your approach to the problem is therefore of keen interest to us. The Swaminathan Foundation has addressed food security in a multi-dimensional manner. The shifting of the focus from yield ceilings to poverty alleviation and the creation of multiple income opportunities are important contributions that we at ICRISAT enthusiastically applaud. Your bio-village program in Pondicherry, which has been the model of this approach for nearly a decade, has demonstrated the viability of adapting such an approach to the issue of food security. Indeed, the efforts of the Swaminathan Foundation to provide technological empowerment to the poor have recently been made fully evident to a very large global audience.

I refer to the award recently received by one of the key players in the Pondicherry initiative, Dr Venkataraman Balaji, who is now the Head of ICRISAT's Information Systems Unit. As most of you know, Dr Balaji was recognized last month for his sterling efforts when he was presented with the World Technology Prize for Education in London. Unfortunately, in their enthusiasm to report this wonderful news to the Indian public, some UK-based journalists erroneously associated Dr Balaji's efforts with ICRISAT. For the record, let me state that we are only too aware that this work was done before he came to us, and that all the credit for the teamwork and backstopping he needed to achieve this award is due to his former colleagues here at the MS Swaminathan Research Foundation.

Another focus ICRISAT shares with the Foundation is the emphasis of gender issues. I know that the gender focus is at the very core of your philosophy on sustainable rural development, and emphatically agree that this is appropriate. Your unwavering focus on the importance of the gender issue has led to many practical measures for internalization in projects within the Foundation. Significantly, it has also led to the creation of India's first Women's Biotechnology Park, which is supported by both the Government of India and Government of Tamil Nadu.

We also value the Foundation's leading role in clarifying policy issues, especially the *Plant Variety Protection Act* and the *Biodiversity Conservation Act* of India. As you know, these are sensitive issues and as guests here in India we look to organizations such as this Foundation for guidance in developing our own strategies.

Of great interest to ICRISAT is the Foundation's unique ability to mobilize support from a variety of organizations: multilateral, bilateral, national, state, and private organizations with an interest in development have all been successfully approached. The Foundation's international network has also been able to motivate hundreds of Indians abroad to form informal support groups.

I would now like to take the opportunity to tell you about ICRISAT's vision and mission for the poor people of the dry tropics.

When I assumed office at ICRISAT in January 2000, I realized, having come from a farming family, that we needed a battle cry in our mission to help the poor of the dry tropics. I felt strongly that there must be an overriding reason, a more encompassing objective behind the seemingly faceless science that we do. This is because ICRISAT

deals not only with crops in the dry tropics. It also helps the poor – the men, women, and children who struggle every day to make both ends meet.

We therefore decided to enhance the human dimension to our research programs and activities. In so doing, we adopted *Science with a Human Face* as the guiding *mantra* for all our endeavors at the Institute.

ICRISAT is an organization that serves poor people first and foremost. Science is a means that we use to serve the poor, not an end in itself. Even if we do excellent research, unless we make an impact on improving the lives of the poor, we have failed. Only by using science to reduce poverty, malnutrition, and environmental degradation can we say that we have made a difference.

Beyond producing quality and cutting edge science, our work at ICRISAT in cooperation with our partners like MSSRF, should benefit the marginalized, the disadvantaged, and the hungry. In other words we tailor our research programs to meet real human needs.

This is the human face of the science and agricultural research that we do. This is the overarching theme of our efforts, the paramount motive of our endeavors. And this is the vision that I would like to share with you today.

Why should we do all of this? The single reason is poverty. In spite of the much-heralded gains of science in increasing food production, there are still nearly a billion people, 13% of the global population, who are poor and food insecure. They are concentrated in developing countries, led by Asia with almost half of its total population still food-insecure, followed by sub-Saharan Africa (35%), and Latin America (17%). Here in India about 84% of the rural poor live in rainfed areas where food is very scarce.

To respond to the foregoing challenge, we have integrated *Science with a Human Face* with our core values of excellence, relevance, openness, partnership, and service. Our specific goals are twofold:

- To make crops more productive, nutritious, affordable, and accessible to the poor.
- To develop tools and techniques for the sustainable utilization of natural resources.

To promote *Science with a Human Face*, we are spearheading a *Grey-to-Green Revolution* in the dry tropics. You may be wondering what a *Grey-to-Green Revolution* means. Most of us are familiar with the Green Revolution of the ’60s and ’70s. It undisputedly had tremendous impact in increasing farm productivity. Without it, a billion people would be hungry today.

It is worth mentioning that while the contributions of international agricultural research centers were crucial, I would like to emphasize that the Green Revolution would not have succeeded without the involvement of the national systems, civil society organizations, and the private sector.

Of particular importance was Professor Swaminathan’s role in India’s *Green Revolution*. Nobel laureate Norman Borlaug praised India’s national research system, then led by Professor Swaminathan, and acknowledged its responsibility for the wheat revolution in this country.

It is true that Green Revolution cereals responded well to inputs such as good water management and fertilizer. Some worried that this benefited richer farmers who could afford these inputs, that richer farmers forced them out of their land and into poverty. Studies in the Punjab and the Philippines, however, found that this was not true. In fact millions of small farmers also benefited.

But while more favorable areas were able to fully optimize the products of the Green Revolution, the dry areas were being left behind. Many worried about this inequity. The notion that the food problem had been solved by the Green Revolution was incorrect.

So as the miracle of the Green Revolution became commonplace in the late 1970s, the world began to ask for more from agricultural scientists. They began to ask us to create a similar miracle for those who had been bypassed, especially those who lived in the harsh, dry areas.

Hence, the need for a *Grey-to-Green Revolution.*

Many people ask us if it is possible to turn grey areas to green. The grey areas are characterized by marginal environments, yearly climate variation, high risks, and scarce capital for the poor. Our challenge is therefore to turn these adversities into opportunities. By doing *Science with a Human Face*, we are happy to share some milestones.

For example, our research on watersheds has shown that farmers can quadruple yields. This can be done simply by managing the rainfall better through proper soil tillage and soil cover, and by harvesting the water in the form of small on-farm reservoirs.

Huge productivity gains could be made in the dry areas by genetically controlling major crop diseases such as fusarium wilt of pigeonpea. This was one of the first major impacts of ICRISAT, working hand-in-hand with government agencies in India.

When diseases of millet such as downy mildew are controlled, farmers reap huge benefits. With our national partners in India, we have accomplished this too.

Similarly, with our partners, we developed early-maturing, wilt-resistant chickpea varieties that extended cultivation further south into the hot, dry areas of central India. This gave farmers an alternative to tobacco and cotton, which were ruining them with high insecticide costs.

In sum, we can make the *Grey-to-Green Revolution* happen. The key is to adapt cropping systems to the natural variability of the environment not the other way around. Adapting the crop to the environment, through better stress, disease, and pest management can result in higher productivity. Adapting the crop to the environment also means farmers get more out of their own natural resource endowment. This approach also helps position them in the global market. By managing and optimizing local resources, poor people can turn adversity into opportunity. This way, they extricate themselves from poverty on their own, without depending on costly inputs or external aid.

The *Grey-to-Green Revolution* is therefore about more than just increasing crop productivity. It's about empowering the poor to build their own capacities, self-confidence, and self-reliance.

In short, the *Grey-to-Green Revolution is science with a human face.*

And the *Grey-to-Green Revolution* is paying off. A study by the Asian Development Bank last year concluded that "Investments in infrastructure, agricultural technology and human capital are now at least as productive in many rainfed areas as in irrigated areas and have a much greater impact on poverty alleviation."

Let me challenge you, committed scientists of this marvelous Foundation and this great country, to do science with a human face. Let us work together to spearhead the *Grey-to-Green Revolution* in the dry areas of India. Rather than allowing the adversities in these regions to daunt us, let us instead transform them into opportunities through quality science.

If we are to realize our vision for the poor and the hungry, if we are to succeed in making science relevant, effective, and efficient in this country, let us do it with a human face!

In closing, let me acknowledge that today the MS Swaminathan Research Foundation is releasing its 11th Annual Report. I am told that it is a tradition here at the Foundation to release the report on August 7th, because this is the Professor's birthday. Well, in the Philippines we take birthdays very seriously.

So, Professor Swaminathan, on behalf of everyone at ICRISAT let me wish you many happy returns of the day, and a very special *Piranda Naal Vaal-thu-gal !*

Serving the Poor: the Challenge to Business Management in India

Speech Delivered during the Fifth Convocation of the DHRUVA College of Management, 17 August 2001, Sundarraya Vignana Kendram, Hyderabad, Andhra Pradesh, India

First of all, allow me to thank the DHRUVA College of Management for inviting me to open this Fifth Convocation and bless its graduating students belonging to batch 1999-2001. Today, I can see pride gleaming in the eyes of graduates, parents, faculty, and staff of the College as it celebrates its Fifth Convocation.

This pride has a solid ground. Since its founding on 15 August, 1995, the College has gone a long way in advancing management education and research. In less than a decade, it has carved its niche in the league of management institutions in Andhra Pradesh if not in the whole of India. I understand that your course is well accepted not only in this state but all over the country. This is shown by the larger number of students coming from other states and even outside the country.

I take particular interest in your holistic approach to management education by interfacing with industry. Along with this, let me congratulate you on your rating last year as the best management institution in terms of interface with industry. I also salute your rating as the second best in intellectual capital and placements in Andhra Pradesh.

Indeed, this interface is very important as you mold future business executives and leaders with a broad vision. This is indispensable as India faces the challenges posed by globalization through the World Trade Organization/GATT agreement.

As investments grow in the country, India will need world-class executives and leaders to steer business concerns which can compete in the world market.

But more important than this, the College must heed the Independence Day pronouncement of the Prime Minister of India to intensify its poverty reduction efforts. To pursue this, tremendous skills are needed to manage rural livelihood enterprises, micro financing, and developing the entrepreneurial capacities of the poor.

Poverty reduction is a gigantic challenge where business management must be involved. A recent report by the World Watch Institute, a Washington DC-based research organization, paints a very challenging picture. By the year 2050 the Indian population will be 1.6 billion, overtaking China as the world's most populous nation. The largest bulk of the Indian people will still be in the rural areas where agriculture is the major source of livelihood. And most of them will still be living in dry, marginal areas where food is very scarce.

At first glance, this looks like a bleak scenario. However, we can look at it as a golden opportunity waiting to be realized. Reducing poverty is an area where the College and ICRISAT come to a common ground. We believe that a synergy between science and management in partnership with a wide range of stakeholders could extricate the poor from poverty and transform India into a world leader in agriculture.

But to help the poor, we must put a human face to management, business, and science.

When I assumed office at ICRISAT in January 2000 I realized, having come from a farming family, that we needed a battle cry in our mission to help the poor of the semi-arid tropics. I felt strongly that there must be an overriding reason, a more encompassing objective behind the seemingly faceless science that we do. This is because ICRISAT deals not only with crops in the semi-arid tropics, it also helps the poor people of the dry tropics – the men, women, and children who struggle every day to make both ends meet.

That is why we decided to strengthen the human dimension to our research programs and activities. To do this, we adopted science with a human face as the guiding light for all our endeavors at the Institute.

ICRISAT is an organization that serves poor people first and foremost. Science is a means that we use to serve the poor, not an end in itself. Even if we do excellent research, if we do not make an impact in improving the lives of the poor, we have failed. Only by using science to help developing countries reduce poverty,

malnutrition, and environmental degradation can we say that we have made a difference.

Beyond producing quality and cutting edge science, our work at ICRISAT in cooperation with our partners should benefit the most marginalized, disadvantaged, and hungry. In other words we tailor our research programs to meet real human needs.

The agricultural research we undertake does not only generate better knowledge about crop genes, production systems, and natural resource management. It also results in increased incomes for farmers and improved quality of life among farm households in the semi-arid tropics.

This is the human face of the science and the agricultural research that we do. This is the overarching theme of our efforts and paramount motive of our endeavors. This is the vision that we at ICRISAT would like to share with upcoming business managers and leaders like you.

Why should we do all of this? The single reason is poverty. In spite of the much-heralded gains of science in increasing food production, there are still about 840 million people, 13% of the global population who are poor and food insecure. They are concentrated in developing countries, led by Asia with almost half of its total population still food-insecure, followed by sub-Saharan Africa and Latin America. In India alone, more than 600 million people do not have enough access to food.

Complementing science with a human face, we are also spearheading a *Grey-to-Green Revolution* in the semi-arid tropics. You may be wondering what a *Grey-to-Green Revolution* means. Most of us are familiar with the Green Revolution of the ’60s and ’70s. Undisputedly, it had tremendous impact in increasing farm productivity. Without it, a billion people would be hungry today.

However, the idea that the food problem has been solved by the Green Revolution is incorrect. It is sobering to realize that a quarter of the world’s people missed the benefits of the Green Revolution.

Many people ask us if it is possible to turn grey areas to green. Well, it’s not easy. The grey areas are characterized by harsh, marginal environments, yearly climate variation, high risks, and scarce capital for the poor. But the good news is that the *Grey-to-Green Revolution* is overcoming these adversities. The key is to adapt cropping systems

to the natural variability of the environment, not the other way around. Adapting the crop to the environment means farmers get more out of their own natural resource endowment. This approach also helps position them in the global market.

The *Grey-to-Green Revolution* is therefore about more than just increasing crop productivity. It's about empowering the poor to build their own capacities, self-confidence and self-reliance.

In short, the Grey-to-Green Revolution is science with a human face.

As I close, let me challenge the DHRUVA College of Management and the graduates to put a human face to business management. Let us work together to spearhead the *Grey-to-Green Revolution* in the dry areas of Andhra Pradesh and the whole of India. Rather than allowing adversities in the dry areas to daunt us, let us instead transform them into opportunities through quality science and management.

Thank you and good day.

Groundnut in the New Millennium: Opportunities and Challenges for Research

Keynote Speech Delivered at the New Millennium International Groundnut Workshop, 4-7 September 2001, Qingdao, China.

Allow me to thank the China Peanut Association and the Organizing Committee of the New Millennium International Groundnut Workshop for inviting me to speak at this prestigious event. I understand that more that 100 peanut scientists from ten countries including China and some international organizations are participating in this workshop. This activity is indeed very important for us to assess the state of groundnut production and utilization as well as the challenges, opportunities, and directions of groundnut research in this millennium.

As we all know, groundnut (or peanut) is one of the major oilseed crops in the world. Groundnut is a valuable cash crop planted by millions of small-scale farmers in the dry areas of Asia, Africa, Central and South America, Australia, and the Caribbean. Groundnut is a very important crop because of its economic, food, and nutritional value. It is a primary source of edible oil and has a high oil and protein content. Moreover, groundnut is a valuable source of vitamins E, K, and B. It is the richest plant source of thiamine, and is also rich in niacin, which is low in cereals. Groundnut cakes, formed after the oil is extracted, are a high protein animal feed.

Groundnut also helps enrich poor soils as it leaves behind nitrogen and thus contributes to the sustainability of production systems.

Most of all, it is very important to the poor in the semi-arid tropics since it generates rural employment especially related to its production, marketing, transportation, and processing. It is worthy to note that 70% of global groundnut production is in the semi-arid tropics.

I would like to highlight the foregoing facts amidst the acute problems of poverty, food insecurity, and malnutrition facing the semi-arid

tropics at present. The semi-arid tropics are home to more than 800 million people. Also, about half of the world's hungry and two-thirds of the world's malnourished children live in the semi-arid tropics.

At present, groundnut is planted in 24 million ha around the world, an increase of 26% since 1980. Of this, 13 million ha are in Asia, mostly in India with about 8 million ha and China with 4 million ha. The rest are in sub-Saharan Africa (9 million ha), and in North and Central America (0.7 million ha).

The current level of global production is 35 million t of pods. Average yields are still low, with less than 1 t ha^{-1} in most countries. Among the developing countries, Argentina and China have higher average yields of more than 2 t ha^{-1}. Here in Asia, China is the leader in terms of productivity, with average yields reaching about 3 t with a net income of $800 per ha in 2000. The Chinese success in groundnut productivity can be attributed to basic things: the adoption of improved varieties and sound crop management.

Please note that the national level of groundnut productivity in China has been surpassed in some provinces like Shandong and Jiangsu. Here the average yield is more than 5 t ha^{-1}. In fact, we have found out that some farmers even get 11 t ha^{-1}!

The high yields of groundnut in China point to the strategic importance of agricultural research. These breakthroughs have been made possible through basic and strategic research in groundnut physiology and other related disciplines. Likewise, improved agronomic practices were developed through adaptive on-farm trials.

Of course, we know that high yields and seed quality of groundnut are limited by several abiotic and biotic constraints. The major abiotic constraints are drought, high and low temperatures, low phosphorus availability especially in acidic soils, and nonavailability of iron in calcareous soils.

The major biotic constraints are diseases and insect pests. Some of these, like rust and leaf spots, are widely distributed globally. Others like groundnut rosette and bacterial wilt are region specific. Moreover, aflatoxin contamination adversely affects the quality of groundnut seeds because of its potential carcinogenic

effect. The contaminated cake obtained after oil extraction is also harmful to animals. Aflatoxin contamination in human food and livestock feed is very severe in Africa, and South and Southeast Asia.

Due to these constraints, groundnut productivity has been stagnant in much of the developing world. Moreover, the adoption of improved varieties and crop management methods remains low, particularly in Africa.

The major reason behind this is the nonavailability of seeds of improved cultivars. Similarly, management recommendations are often too costly for poor farmers. These are further aggravated by weak research-extension-farmer linkages.

Based on the foregoing constraints, our current research program at ICRISAT focuses on six major themes.

These are:

1. Management of drought.
2. Management of aflatoxin contamination.
3. Management of foliar diseases.
4. Management of virus diseases.
5. High yield and adaptation to diverse growing conditions and utilization.
6. Technology sharing, which includes seed production and delivery systems.

Research on groundnut has high priority at ICRISAT because of the crop's important dietary contribution, its use as a cash crop and income generator, and its potential in meeting part of the global demand for vegetable oils. Moreover, it has significant value as animal feed and fodder and it contributes to the sustainability of mixed cropping systems. We believe that research on groundnut can resolve major production constraints.

On the whole, our groundnut research program focuses on the development and utilization of high-yielding, adapted cultivars with multiple resistances to biotic and abiotic stresses. Our goal is to reduce agrochemical use by farmers and health risks among consumers.

By doing this we could help enhance and sustain groundnut

productivity to subsistence farmers in the semi-arid tropics.

Thus, aside from conventional breeding we are also applying newer sciences such as genetic transformation, molecular marker-assisted breeding, bio-control, botanical pesticides, and others in developing a management strategy for groundnut.

I am also happy to inform you that ICRISAT holds the largest collection of groundnut germplasm in the world. At present we have 15,342 accessions including 416 wild *Arachis* species from 92 countries. These genetic resources are freely available to you. For instance 37,591 accessions were made available to scientists in 45 countries from 1990 to 2000.

During the same period, we also supplied 13,183 advanced breeding lines and segregating populations to our collaborators in Asia and Africa. From these, they were able to release 25 cultivars in Asia and 19 in Africa.

Groundnut is a relatively young crop, is still evolving, and remains under-researched. In spite of its socioeconomic importance, especially to the poor, the global investment in groundnut research is comparatively low. The CGIAR's research investment in groundnut is about US$ 5.7 million. This represents just about 2% of the CGIAR's commodity research investment.

The majority of research funds for groundnut originate from the public sector. The private sector does not find the crop profitable for their commercial ventures.

In this situation, partnerships among research institutions are very important as they bring in synergies in expertise, resource mobilization, and effective and efficient output generation. Hence, special research projects on groundnut are supported by donors at ICRISAT. These are conducted in partnership with national agricultural research systems (NARS) and advanced research institutes (ARIs).

Partnership between China and ICRISAT started way back in 1988 when we signed a Memorandum of Understanding with the Chinese Academy of Agricultural Sciences. This further intensified when China became a member of the Cereals and Legumes Asia Network, or CLAN. The CLAN is a network of agricultural scientists in Asia. Currently, 13 Asian countries are members of CLAN: Bangladesh, China, India, Indonesia, Iran, Myanmar, Nepal, Pakistan, Philippines,

Sri Lanka, Thailand, Vietnam, and Yemen. The overall goal of the network is to uplift the well-being of Asian farmers and consumers by improving the productivity of sorghum, pearl millet, chickpea, pigeonpea, and groundnut in a sustainable manner.

Scientists and administrators of CLAN were impressed by the 11 t yield obtained here in China and wanted to learn more about the technologies that helped achieve these.

Hence in 1995, CLAN organized a workshop in Laix, Shandong, China so that scientists from other Asian countries could learn first hand about the high yield groundnut production technologies. ICRISAT, the Chinese Academy of Agricultural Sciences (CAAS), and the Shandong Academy of Agricultural Sciences (SAAS) co-sponsored the activity.

Scientists from 13 provinces in China, India, Korea, Myanmar, Philippines, Thailand, Vietnam, and ICRISAT participated in the workshop. They also visited the fields to see the technologies practiced by Shandong farmers. This was a landmark workshop that involved South-South cooperation in technology exchange and enabled scientists from other countries to learn the improved technologies being practiced in China.

As a result of the workshop, the polythene mulch technology which is a component of the high yield technology has been tested in India and Vietnam. Through this technology alone, 30-60% increase in yield has been attained. Other improved agronomic practices like applying FYM, fertilizer management, seed dressing, application of growth regulators, and pest management have also been shared with other countries.

Constraints faced by groundnut farmers around the world and the initial successes of groundnut productivity in China open great challenges for groundnut research in this millennium. Ten years from now, we foresee that groundnut production and consumption will shift increasingly to developing countries. Production will grow in all regions but most rapidly in Asia. Per capita consumption will also grow

sharply in Asia, slowly in sub-Saharan Africa, and decline in Latin America. Globally, utilization will continue to shift away from groundnut oil to food especially for direct consumption and confectionery products. But in many countries, the crop will still remain a major source of edible oil.

Groundnut area and production will grow further than they did in the 1970s and 1980s. The share of groundnut in total oilseed production will remain stable.

Due to the increasing demand for edible oils and the continuing poverty of our farmers in the semi-arid tropics, we need to further improve the productivity of groundnut.

We must use science to enhance the opportunities for poor farmers from groundnut oil and haulms. This can be realized with the continued development and sharing of improved groundnut production technologies.

Thus six years after Shandong, this *New Millennium Workshop*, is indeed very strategic in enhancing groundnut production and utilization in the world. Let me identify the major challenges we need to address:

1. The need to increase the supply of vegetable oil for the growing world population.
2. The importance of groundnut in protein supplementation for children, pregnant and nursing mothers, and the poor.
3. The increasing importance of groundnut as a food crop, in addition to its traditional role as an oil crop.
4. The need to enhance nutritional quality parameters like essential amino acids and fatty acids.
5. Reduction of aflatoxin contamination in groundnut and its products for domestic consumption and international trade.
6. Mechanization to make groundnut cultivation easier and more efficient.
7. Enhancing partnerships with the private sector and NGOs to enhance market demand.

8. Studying trade policies and the effect of WTO on groundnut trade and farmers' income.

Considering the foregoing scenario and the challenges ahead of us, we propose a two-pronged approach for groundnut research in the future. This will involve the utilization of newer sciences in resolving past and future problems, and a farmer-participatory approach in technology development and sharing to optimize returns of investment in groundnut research.

New tools such as genetic transformation, marker-assisted selection, GIS, modeling, and forecasting pest epidemics will play a greater role in the science and technology of groundnut production. Likewise, substantial investments will be required in seed production and delivery systems to accelerate technology utilization. Linkages among research, extension, and farmers also need to be strengthened, especially through on-farm participatory research.

But above all of these, our greatest challenge in this millennium is to put a human face to the science that we do for groundnut. We must use science as a means to serve the poor, not as an end in itself. Even if we do excellent research, if we do not make an impact in improving the lives of poor groundnut farmers, we have failed.

Beyond producing sufficient quantity and quality of groundnut through cutting edge science, our work should benefit the most marginalized, disadvantaged, and hungry. In other words, we should tailor our research programs to meet the concrete needs of our farmers.

This is the human face of the science and the agricultural research that we do. This should be the overarching theme of our efforts and paramount motive of our endeavors. This is the vision that we at ICRISAT would like to share in this workshop.

Through *Science with a Human Face*, we can wage a *Grey-to-Green Revolution* in the semi-arid tropics. You may be wondering what a *Grey-to-Green Revolution* means. Most of us are familiar with the Green Revolution of the '60s and '70s. It undisputedly had tremendous impact in increasing farm productivity. Without it, a billion people would be hungry today.

However, the idea that the food problem has been solved by the Green Revolution is incorrect. It is sobering to realize that a quarter of the world's people missed the benefits of the Green Revolution. Many

people ask us if it is possible to turn grey areas to green. Well, it's not easy. The grey areas are characterized by harsh, marginal environments, yearly climate variation, high risks, and scarce capital for the poor. But the good news is that the *Grey-to-Green Revolution* is overcoming these adversities. The key is to adapt cropping systems to the natural variability of the environment, not the other way around. Adapting the crop to the environment means farmers get more out of their own natural resource endowment. This approach also helps position them in the global market.

In the *Grey-to-Green Revolution* we help empower the poor to manage their local resources and put them to much better use. By managing and optimizing local resources, poor people can turn adversity into opportunity. This way they extricate themselves from poverty on their own without depending on costly inputs or external aid.

The *Grey-to-Green Revolution* is therefore about more than just increasing groundnut productivity. It's about empowering the poor to build their own capacities, self-confidence, and self-reliance.

In short, the Grey-to-Green Revolution is science with a human face.

As I close, let me challenge you, as the world's leading groundnut scientists, to do *Science with a Human Face*. I am confident that our workshop will be a significant step towards this.

Thank you and good morning.

Biotechnology for the Poor: an India-ICRISAT Initiative in India

Welcome Remarks During the Workshop on the Development and Use of Biotechnology for Improving Semi-Arid Crops of India: Initiative of the Department of Biotechnology (DBT) and ICRISAT for Collaborative Research, 11 September 2001, ICRISAT, Patancheru, Andhra Pradesh, India

Ladies and gentlemen, good morning.

It is my great pleasure to welcome you to ICRISAT and this workshop on the *Development and Use of Biotechnology for the Improvement of Crops in the Semi-Arid Regions of India.* This workshop came out of my meeting with DBT Secretary Dr Manju Sharma in Delhi on 20 July 2001. In our meeting, we decided to organize this one-day activity to further discuss opportunities for possible collaboration between DBT, Indian NARS, and ICRISAT.

Harnessing biotechnology for the poor is one of six global research themes we are currently developing at ICRISAT in line with our new vision and strategy. Under this theme, we emphasize biotechnological approaches to crop improvement especially for traits most relevant to poor farmers and consumers in the dry tropics. We also seek greater opportunities to utilize available genetic diversity. Our main concerns are to increase yield and quality, decrease losses due to abiotic and biotic stresses, and to enhance nutritional traits. Most laboratory activities will be carried out here in Asia. Nevertheless the target environments will also include the dry tropics of Africa and South America.

Some of you may not know it, but modest collaboration between DBT and ICRISAT already exists, although largely informal. DBT is directly involved in biosafety administration at ICRISAT. Similarly, many DBT scientists including those supported by the department are in close contact with us. On the other hand, ICRISAT scientists serve in DBT committees to develop network projects or serve as advisors in curriculum development in DBT-sponsored degree programs. Our scientists are also involved in assisting universities and other institutions in India to help develop biotechnology projects.

As early as 1998 during the visit of Dr Sharma to ICRISAT-Patancheru, some areas of collaboration were already identified. However, these need to be reviewed in the light of our rapidly changing task environment, technology, and new opportunities for collaboration.

Under my stewardship, I envision that our collaboration will broaden options of our farmers in the dry tropics of this country. Ultimately, this should increase the diversity, income, and sustainability of agriculture in these regions and contribute to the *Grey-to-Green Revolution.*

Our scientists in the Genetic Resources and Enhancement Program have long been involved in developing tools of molecular biology for the mandate crops of the Institute, namely chickpea, groundnut, pearl millet, pigeonpea, and sorghum. Through these efforts we are now in a position to apply these tools in developing cultivars that can tolerate drought and resist major diseases and insect pests.

For example, we now have usable molecular marker-based genetic linkage maps of chickpea, pearl millet, and sorghum. We are using these to map gene blocks that can reduce the vulnerability of these crops to the most damaging biotic and abiotic stresses.

In sorghum, highly polymorphic microsatellite markers are now available in reasonable numbers. Due to this, high-throughput marker genotyping for mapping populations and marker-assisted breeding programs can now be done. This could be demonstrated in India by marker-assisted backcrossing of gene blocks contributing to the *stay-green* component of terminal drought tolerance. This has been initiated by ICRISAT in India in economically important sorghum open-pollinated varieties such as M 35-1 and more recently developed hybrid parental lines such as 296B. Additional support from DBT will allow this to be completed more rapidly and perhaps even expanded to include other sorghum cultivars and hybrid parents important to Indian farmers.

In chickpea, we are now using quantitative trait locus mapping procedures to identify genomic regions that can contribute to superior agronomic performance under drought stress. Again, we have a reasonable number of highly polymorphic microsatellite markers available in this crop. These will allow the rapid generation of marker data for random inbred line populations that are being developed to study the inheritance of this complex trait. Of course, additional polymorphic markers will always be welcome.

For enhancing resistance to pests and diseases, work is already well under way to map genes for fusarium wilt resistance of chickpea, and for shootfly, stem borer, and midge resistance in sorghum. In addition efficient systems for genetic transformation of these crops have been developed here at ICRISAT-Patancheru.

Hence, we are now in a position to evaluate the potential of *Bt* sorghum and chickpea in controlling stemborers and podborers, respectively.

These tools can also be applied to improve the nutritional as well as organoleptic quality of grain. In sorghum, one of our greatest opportunities will come from the resolution of the grain mold problem during the rainy season.

Bioinformatics is an area we are just beginning to explore. Initially, work in this area will help us identify additional microsatellite markers from genome sequence data for our crops globally available in public databases. We have already done this in sorghum, identifying the potential to develop another 300 microsatellite markers from existing sequence data. The computational genomics portion of bioinformatics will also help us to deal with the vast amounts of data that are being generated, and identifying related regions in the genomes of various crop species.

Thus, there are many opportunities now available in applying the tools of molecular biology to the breeding of improved crop cultivars. Please note that initial collaborative activities will focus on sorghum and chickpea. The priority traits to be dealt with were also discussed during the Delhi meeting and will include disease resistance, drought tolerance, and grain quality. Throughout this workshop, I am confident that these will be thoroughly discussed in the context of a strong collaboration between ICRISAT and the DBT. I would also like to see discussions on common interests and the mapping out of an implementable collaborative program that will ultimately benefit our farmers.

I do not wish to pre-empt your discussions in the workshop, but before I close, let me pose one big challenge.

We must have a positive impact on the lives of poor farmers in the dry areas of this country in the shortest time possible. It is only through this impact on the poor that our science can truly show its human face. Science, and more specifically, biotechnology, should be a means that we use to serve the poor, not an end in itself. Even if we

do excellent research, if we have no impact in improving the lives of the poor, we have failed. Only by using biotechnology to help reduce poverty, malnutrition, and environmental degradation in the dry areas of India can we say that we have made a big difference.

Hence the collaborative research we will undertake should not only generate knowledge about biotechnology. We must aim to share and apply this knowledge to increase the income of our farmers and improve their quality of life.

This is the human face of the science and collaborative research that we do. This should serve as the overarching theme of our efforts, the paramount motive of our endeavors. This is the vision that we would like to share with DBT in this workshop.

At this point, let me thank and congratulate the ICRISAT-DBT team who worked hard to organize this workshop. I hope that after today, we will have a viable collaborative program that can produce improved technologies which will reach our farmers in 3 to 5 years.

Thank you and good morning.

A Human Face to Science and Technology: the Challenge to CSIR

Speech Delivered during the 59th Foundation Day of the Council of Scientific and Industrial Research (CSIR), 26 September 2001, IICT, Hyderabad, Andhra Pradesh, India

First of all, let me thank the Indian Institute of Chemical Technology (IICT) of the Council of Scientific and Industrial Research (CSIR) for inviting me as the Chief Guest on its 59th Foundation Day including the launching of the new GC-EAD and allied facilities at the Center for Pheromone Research.

It is indeed an honor to be the invited guest of India's premier research and development organization. I understand that CSIR is the world's largest public funded industrial R&D agency. And I gather that IICT, under the leadership of Dr KV Raghavan, has been one of the leading performers in terms of scientific achievements in the area of chemical technology.

CSIR is a very strategic organization since it provides scientific and technological inputs to the economic, industrial, and societal sectors needed for the development of India. This can be gleaned from the Rs 30 billion worth of industrial production generated by CSIR technologies every year. Likewise, CSIR earns US$ 3 million worth of foreign business every year.

I learned that the CSIR R&D program covers a broad spectrum of concerns ranging from aerospace engineering to ocean sciences, molecular biology to metallurgy, chemicals to mining, food to petroleum, and leather to environment.

These are the strategic concerns that will propel India into the 21st century.

In 59 years, CSIR has indeed gone a long way in harnessing science and technology for the development of India. As an autonomous

body, it earns distinction by being headed by no less than the Prime Minister.

With 41 Institutes employing more than 30,000 staff spearheaded by 7,000 scientists and technologists, CSIR is India's potent instrument for modernization and social change.

Similar to ICRISAT, I recognize CSIR's and IICT's efforts to mobilize science and technology for economic growth and human welfare. This is done on three fronts with the Institute serving as a partner of Indian industry, enabling it to emerge as a significant global player.

It also assists the nation in deriving enhanced and sustainable value from endogenous resources.

Most of all, it provides S&T based solutions to mitigate vulnerability and improve the quality of life, especially of the weaker sectors of society.

Beyond this however, I am very happy to note that CSIR and ICRISAT share the same vision of being model R&D organizations, global in reach, and imbued with a societal mission to do *Science with a Human Face*.

When I assumed office at ICRISAT in January 2000, I realized, having come from a farming family, that we needed a battle cry in our mission to help the poor of the semi-arid tropics.

I felt strongly that there must be an overriding reason, a more encompassing objective behind the seemingly faceless science that we do.

This is because ICRISAT does not only deal with crops in the semi-arid tropics. More than this, it helps the poor of the dry tropics – the men, women and children who struggle every day to make both ends meet.

That is why we decided to strengthen the human dimension to our research programs and activities. To do this, we adopted *Science with a Human Face* as the guiding light for all our endeavors at the Institute.

ICRISAT is an organization that serves poor people first and foremost. Science is a means that we use to serve the poor, not an end in itself.

Even if we do excellent research, if we do not make an impact in improving the lives of the poor, we have failed.

Only by using science to help developing countries reduce poverty, malnutrition, and environmental degradation can we say that we have made a difference.

Beyond producing quality and cutting edge science, our work at ICRISAT in cooperation with our partners, should benefit the most marginalized, disadvantaged, and hungry. In other words, we tailor our research programs to meet real human needs.

The agricultural research we undertake does not only generate better knowledge about crop genes, production systems, and natural resource management. It also results in increased incomes for farmers and improved quality of life among farm households in the semi-arid tropics of the world.

This is the human face of the science and the agricultural research that we do. This is the overarching theme of our efforts and paramount motive of our endeavors.

This is the vision that we at ICRISAT would like to share with CSIR and IICT today.

Why should we do all of this? The single reason is poverty. In spite of the much heralded gains of science in increasing food production, there are still about 840 million people, 13% of the global population who are poor and food insecure.

They are concentrated in developing countries, led by Asia with almost half of its total population still food-insecure, followed by sub-Saharan Africa (35%), and Latin America (17%). In India, about 84% of the rural poor live in rainfed areas where food is very scarce, inaccessible, and unaffordable.

To respond to the foregoing challenge, we have woven *Science with a Human Face* into our mission and medium term plan for 2001 to 2003.

ICRISAT's new mission is "to help the poor of the semi-arid tropics through science with a human face and partnership-based research and to increase agricultural productivity and food security, reduce poverty, and protect the environment in SAT production systems".

To put this into motion, we mapped out two goals:

1. To make crops in the semi-arid tropics more productive, nutritious, affordable, and accessible to the poor.
2. To develop tools and techniques for the sustainable utilization of natural resources in the semi-arid tropics.

In order to pursue these goals, we are implementing ten projects.

First is raising soil productivity to help farmers grow their way out of poverty. Our goal here is to develop integrated soil, water, and nutrient management options to raise system productivity, increase the adaptive capacity of ecosystems, and enable rural households to face risk and change.

Second is the efficient management of natural resources in watersheds. Through this project, we aim to increase and improve rural livelihoods through better management of natural resources in agricultural watersheds.

Third is integrated pest management aimed at reducing environmental hazards through eco-friendly pest and disease management technologies.

Fourth is saving and utilizing biodiversity so as to secure and conserve the genetic diversity of crops in the semi-arid tropics.

Fifth is biotechnology. This aims to apply biotechnology so that it enhances the efficiency, effectiveness, speed, and precision of plant breeding.

Sixth is genetic diversification and enhancement. Our goal here is to diversify the genes of improved germplasm and cultivars with high and stable yield, acceptable quality, and resistance to biotic and abiotic stresses.

Seventh is improving seed supply to make seeds available and affordable to farmers.

Eighth is enhancing the impact of agricultural research in the semi-arid tropics by improving the efficiency of agricultural research systems and their policy environment.

Ninth is linking increased productivity with poverty reduction by providing an analytical basis in prioritizing investments in technology development to optimize impact.

Tenth is knowledge sharing by optimizing information flows between ICRISAT and its stakeholders.

Complementing *Science with a Human Face*, we are also spearheading a *Grey-to-Green Revolution* in the semi-arid tropics.

You may be wondering what a *Grey-to-Green Revolution* means. Most of us are familiar with the Green Revolution of the '60s and '70s. Undisputedly, it had tremendous impact in increasing farm productivity.

Without it a billion people would be hungry today.

However, the idea that the food problem has been solved by the Green Revolution is incorrect. It is sobering to realize that a quarter of the world's people missed the benefits of the Green Revolution.

Many people ask us if it is possible to turn grey areas to green. Well, it's not easy. The grey areas are characterized by harsh, marginal environments, yearly climate variation, high risks, and scarce capital for the poor.

But the good news is that the *Grey-to-Green Revolution* is overcoming these adversities. The key is to adapt cropping systems to the natural variability of the environment, not the other way around.

Adapting the crop to the environment means farmers get more out of their own natural resource endowment. This approach also helps position them in the global market.

In the *Grey-to-Green Revolution*, we help empower the poor to manage their local resources and put them to much better use. By managing and optimizing local resources, poor people can turn adversity into opportunity, then into growth and development.

This way, they extricate themselves from poverty on their own, without depending on costly inputs or external aid.

The *Grey-to-Green Revolution* is therefore about more than just increasing crop productivity. It's about empowering people especially the poor to build their own capacities, self-confidence and self-reliance.

In short, the Grey-to-Green Revolution is science with a human face.

As I close, let me congratulate the CSIR and IICT, its officers led by

Dr KV Raghavan, staff, and partners on its 59th Foundation Day. I am impressed with the breakthroughs you have generated which are considered 'firsts' in the world and very significant.

In technology, the generation of:

1. Centchroman – a nonsteroidal, oral, once-a-week female contraceptive.
2. A single step process (including catalyst) for manufacture of adepic acid.
3. Green technology for linear alkyl benzene.
4. Infant food using buffalo milk.

In science, the discovery of:

1. The first ever flowering and seeding of tissue cultured bamboo.
2. One of the smallest protein molecules, 'seminal plasmin'.
3. *Chainia*, the microorganism with the smallest molecular weight.

Let me also express ICRISAT's support to the attainment of your goals this year:

- The move towards self financing by generating over Rs 7 billion from external sources.
- Developing at least ten exclusive and globally competitive technologies in niche areas.

But most of all, let me challenge CSIR, much more IICT, to help realize ICRISAT's vision for the poor and the hungry by making science relevant, effective, and efficient in this country.

This can be done by doing *Science with a Human Face!*

Thank you and good day.

Fighting Hunger and Poverty

Speech Delivered on the Occasion of the Regional World Food Day Observance at the Regional Office of the Food and Agriculture Organization, 16 October 2001, Bangkok, Thailand

Your Royal Highness Princess Maha Chakri Sirindhorn, Dr RB Singh, Assistant Director General and FAO Regional Representative for Asia and the Pacific.

I am deeply honored to have been asked to speak to you today. Thailand is a country close to my heart, where I have always felt welcome – earlier as a representative of the Government of the Philippines, and more recently as Director General of ICRISAT. ICRISAT, as you know, has a global mandate for research on groundnut, a crop of increasing importance in this country. Our scientists are working in close collaboration with Thai scientists to provide advanced lines suited to the conditions of Thailand. Another facet of agricultural development identified for collaboration between us is watershed management.

Allow me, Your Highness, to congratulate the efforts of the Royal Family in its support of the Ministry of Agriculture to provide the hard-working farmers of this country with products and technologies tailored to their needs.

I am also very proud that my long-time friend and colleague Dr RB Singh has been designated Assistant Director General and Regional Representative of the FAO. Dr Singh and I go way back to the early days of APAARI, and I wholeheartedly congratulate you, old friend, on your well-deserved appointment.

The topic of my address this morning concerns the worst scourge of the new century: *hunger*. Hunger is unacceptable. It must cease. Man has climbed the highest peaks. He has explored the deepest depths. He has walked on the moon. The human genome has been mapped. Atoms have been split. Technology is becoming ever more

sophisticated. Scientific advances abound. But still we are faced with hunger throughout the world. Why is this? What can we do to stop it, once and for all?

It's not that progress in agricultural science has not kept pace with other scientific endeavors. Indeed, some of the most spectacular advances in human history have been accomplished in the field of agriculture.

During the late '60s and '70s, for example, the Green Revolution drew the entire world's attention to the power of new technologies to accelerate agricultural development. Massive famines, considered inevitable by some, were narrowly avoided through the hard work and dedication of international and national researchers working closely with government officials.

This success story remains one of the shining achievements of our time. But the very architects of that revolution cautioned the world not to rest on their laurels. They warned that it would be difficult if not impossible to repeat. While the Green Revolution had bought time, they said, it could not indefinitely postpone the collision course between population growth and food production.

With the food problem seemingly under control, the world's attention shifted to other issues such as environmental degradation and social equity. Some people even became suspicious of the Green Revolution, noting that while wealthier farmers with larger, high-quality land holdings and access to inputs were capable of capitalizing on the new technologies, the rural poor were left further behind than ever.

In response, researchers were asked to find ways of using technology to improve equity, decrease gender gaps, and bias benefits toward the poorest of the poor. Despite initial doubts, however, impacts in these areas are now emerging as substantial and well targeted towards poverty reduction.

At present, many concerned organizations are pinning their hopes on biotechnology and information technology to provide another major jump in production – a jump that might be comparable to the Green Revolution itself. At the same time, there is an increasing realization that with the globalization of agriculture, commodity prices are likely to decline and efficient production will be the key to survival in agriculture, as in other industries. Inefficient producers and production systems will fall by the wayside. The future may well lie in adapting the

cropping system to environmental diversity, making the most of the different natural resource endowments of different agroecological zones – rather than using costly inputs to change the environment.

It is difficult to overstate the significance of the Green Revolution. If it had not occurred, an extra billion people would be hungry today.

The astounding impact of the Green Revolution prompted many economists to examine its causes and lessons in detail. A recent study by the Asian Development Bank found that its research-for-development investments have consistently yielded a greater return than direct subsidies to agriculture. Rates of return ranged from 20 to 60% – far more than returns for non-research investments. The ADB also found that by including a research component in their agricultural development projects, their chances of success were significantly enhanced.

Economic studies found that the Green Revolution's benefits extended beyond the lofty objective of feeding the teeming masses of poor. They demonstrated that agricultural development was an engine of economic growth that broadly reduced poverty. Much of the economic surplus generated by increased productivity was being spent on other goods and services – helping developing countries diversify their economies beyond agriculture, and providing spin-offs such as greater accessibility of goods and services like education and health care.

Expressed at the human level, many people who grew up in poor rural households – and here I can speak from the heart because that's where I come from – know that farm families have long viewed increases in farm income as a way to help our children get a better education and a good job in the city, escaping the cycle of rural poverty.

From this mass of evidence it is clear that investment in agricultural research during the Green Revolution era yielded, and continues to yield, very attractive returns to development investors.

But there is an ironic turn to this story of success. Although the Green Revolution saved the planet from the horrible consequences of mass starvation, its stunning achievements were never fully appreciated by the world community. Unfortunately, without a clear sign of calamity – without corpses – little attention is aroused. The rewards that come to those who *prevent* tragedy are rarely commensurate with the rewards reaped by those who *react* to it. The sad events that

occurred in New York and Washington last month are positive proof of this understandable but unfortunate side of human nature.

The irony goes even further, because the enhanced productivity combined with protective policies and subsidies contributed to a food glut in the developed countries that caused many living in those fortunate circumstances to think that the world food problem had become one of excess, not shortage.

But this was clearly an illusion. Despite the increasing availability of food 13% of the global population, about 840 million people, are food insecure. Predictably, this food insecurity is concentrated in developing countries, with a regional breakdown led by Asia in both numbers and proportions (48% food insecure), followed by Africa (35%) and Latin America (17%).

The root of this paradox is poverty. The poor simply cannot afford to buy the food they need. Even subsistence farmers must purchase significant portions of their annual food supply. Although the Green Revolution dramatically reduced food prices, huge numbers of poor still live on the edge of despair.

So where are we now? Many subsistence farmers on rainfed lands have yet to benefit from improved varieties. The Green Revolution varieties, bred to respond to good soil fertility, water supply, and pest control, were not advantageous under more stressful conditions. A quarter of the world's people and rainfed and marginal areas missed the Green Revolution party.

These marginal areas and neglected peoples are the source of rapid population growth and environmental degradation. But much can be learned by striving to understand traditional practices that are by definition based on ecologically friendly principles such as shifting cultivation, intercropping, and tailoring crops and crop management systems to local conditions, instead of trying to suit the environment to the crop.

The wisdom of relative investments in favorable versus marginal environments has been a controversial issue since the mid '80s. The Green Revolution experience taught that more favorable areas generated larger responses to inputs at lower costs per unit output. But partly as a result of the longstanding priority accorded to those favorable areas, many of the readily obtainable gains have already been achieved in these areas.

It should come as no surprise that progress in marginal areas has taken decades to bear fruit. It is often forgotten that the impact of the Green Revolution took 20 years to make itself felt after the initial Ford and Rockefeller investments in short-duration wheat in Mexico. In only a slightly greater time frame, the investments of the CGIAR and its partners in marginal lands have begun to pay off handsomely, despite the greater complexity of the challenges and variability of the environments.

Recent evidence, such as the econometric analysis of district level data in India reported by Fan and Hazell in their seminal 1999 paper, is revealing that carefully targeted investments in marginal areas are delivering comparable or even greater returns than in favored areas. A recent study by the ADB concluded that, and I quote:

Investments in infrastructure, agricultural, technology, and human capital are now at least as productive in many rainfed areas as in irrigated areas and have a much greater impact on poverty alleviation.

End quote.

Not only cereals, but improved food legume varieties are being enthusiastically adopted in dry marginal areas. Shortening the crop growth cycle by a third or more for pigeonpea and chickpea has enabled farmers to plant these protein-rich pulse crops before or after cereals in South Asia, substantially raising farmers' incomes while diversifying their operations and improving their diets.

The achievements of the Green Revolution also fostered hopes that agricultural development could be more specifically targeted towards the more disadvantaged people within society, particularly women and children. According to a WHO report, women constitute only one-third of the world's work force, yet they work two-thirds of the total hours, for which they receive only 10% of the total income, and own less than 1% of the total property.

It is hardly surprising that women also highly value reductions in drudgery and occupational hazards, in addition to enhanced income. Asked what she would do with the extra income chickpea cultivation had brought to her family, one Bangladeshi woman replied that she would now be able to send her daughter to school. Previously only her sons were allowed to go. This illustrates the need to take a broader view of poverty than the simplistic view of economic advancement.

The broadening of the international agricultural research centers' agenda during the late '80s and '90s put major strains on its capacity to deliver. Funding had not increased in proportion to expectations, and many thought that the system's reach now exceeded its grasp.

The same pressures befell national research programs. As it became clear that no single organization could fully address the complexity of the new agenda, these international and national organizations realized that they would have to greatly expand their partnerships.

As a result, partnerships among all sorts of organizations – international and national, public and private, governmental and non-governmental – grew rapidly in number, diversity, and scope. Steadily, the array of institutions engaged in agricultural research and development interlinked themselves in an ever-tighter fabric of partnerships.

The closest partners of the CGIAR Centers have always been the government research and development agencies responsible for agriculture. Increasingly, however, collaborative arrangements with NGOs and the private sector are emerging. Such collaborative activities frequently have comparative advantages for strategic or applied research. Being closely focused on near-term impact, these new partners are helping us and our national colleagues translate our findings quickly into impact on the ground.

An excellent example of the dynamism of such partnerships is the success of recent collaboration between ICRISAT and Indian hybrid seed companies. Several companies are now contributing funds to ICRISAT's applied plant breeding work, without any intellectual property or germplasm restrictions and without constraining the research priority set. They have come to realize that 'a rising tide lifts all boats' – that they, as well as others, stand to gain from advances in public sector knowledge and genetic materials.

The amounts of these contributions are modest, and do not come close to replacing public sector investments. But that's not the point. We view these tangible signs as an important vote of confidence in these partnerships, and such confidence bodes well for the future of agricultural research.

But let's not get overly optimistic. Between 1980 and 1990, according to IFPRI, the International Food Policy Research Institute, agricultural development investment as a percentage of total world development assistance fell from 20 to 14%, and has continued to decline since

then. Ordinary people in developed countries, once alarmed by the specter of global famine and the haunting, skeletal faces of starving babies on their TV screens, have now become inured to these images.

This is understandable, but the policymakers of developed countries need to realize that the spillover benefits to their own agricultural prosperity derived from research conducted in the developing world have far exceeded their investments. The givers have got their own back many times over. And far from posing a competitive threat, by helping the poor escape poverty they have created vast new markets for their own exports. Investments in fighting hunger and poverty results to significant reduction of landlessness, despair, and terrorism.

Developing countries are equally guilty. During the period 1981-85, the Australian social observer Derek Tribe estimated that developing countries invested only about 0.41% of the value of their agricultural gross domestic product in research, less than a fourth of the average 2% investment made by developed countries.

To rekindle the fire of the Green Revolution, we need to articulate in modern, compelling terms the best-kept secret of the enormous benefit the world has enjoyed from its investments in agricultural research. The message we must convey is that because we all live in an interconnected world, investments in development (i.e., the fight against hunger and poverty) protect us all from the suffering, strife, and terrorism that command the world's attention today.

The Green Revolution raised expectations for a continued flow of scientific miracles. This legacy frames the challenge for today's generation of dedicated research and development professionals. What are our chances?

The promise of biotechnology to increase crop and animal productivity while reducing losses caused by pests and diseases is enormous. Massive problems such as drought, voracious insects, physiological inefficiencies, and disease resistance breakdowns no longer seem as intractable as they once were.

The potential impacts of biotechnology are huge. But the challenges are not only biological – they are also institutional, financial, and even legal. But there is little doubt that the proper use of biotechnological tools can add further productivity gains while protecting the environment, as long as it is directed toward the public good.

Many patents are now being issued restricting public sector access to such fundamental research knowledge as genes and laboratory methodologies for gene manipulation. These patents are equally restrictive toward the orphan crops of the poor. These technologies need to be made available so that public sector organizations can use them to deliver their promise to the poor.

A key role for international centers is to serve as facilitators – brokers if you like – who can negotiate appropriate arrangements between the public and private sectors as we navigate the road ahead. The international agricultural centers, independent as they are of political or profit motives, have proven their effectiveness as catalysts in such partnerships.

The global revolution in information and communication technology holds equally dazzling potential. The complex, system-oriented solutions required of today's agricultural research are more knowledge-intensive than the simpler seed-centered technologies that drove the Green Revolution.

In the Green Revolution model, it was necessary to provide large amounts of costly inputs to homogenize the agro-environment so as to remove all constraints to yield potential. In the new era, global competitiveness and production efficiency will become paramount. Information will become a key strategic resource, enabling farmers to better tailor their crops and management to their particular locales and conditions, extracting the most efficient use of the endowment they have at hand.

Extension or farmer organizations, even in remote villages, are now able to dial up the Internet over the telephone to obtain information on input and crop commodity prices, seed availability, weather, management recommendations, pest and disease epidemic forecasts, and other valuable insights.

The same channels can be used by farmers to feed back their own observations and knowledge so that researchers, policy makers, and the press will have a better understanding of realities on the ground. It will no longer be possible for governments to ignore the rural poor simply because of their geographic isolation.

Better communications will lead to stronger partnerships among research and development organizations. Virtual teams will be quickly formed through searches over the Internet, finding just the right expertise for important problems.

It is not surprising that an achievement as marvelous as the Green Revolution resulted in such diverse and far-reaching outcomes as those I have described. But its ramifications continue to affect the lives of people all over the globe to this day. Surpassing the expectations of most, while falling short of the broad social goals of some, it remains a phenomenon held in both awe and controversy. Nevertheless, all will agree that it serves as a potent example of science in service of development – which we at ICRISAT call *Science with a Human Face*.

The Green Revolution bought precious time for our global village – an opportunity to bring population and environmental deterioration under control before they outrace our capacity to increase food supplies. This precious interval has enabled scientists to develop even more powerful tools that many believe will unleash a second Green Revolution – a revolution that employs all the tools at our disposal, including biotechnology and information/communication technologies – a revolution that turns grey to green, the *Grey-to-Green Revolution* for the dry tropics of the world.

If we do our job well, the result will be a more just, prosperous, equitable, and food secure world – a world with the wisdom and resources to tame the monsters of overpopulation and environmental degradation. If we are successful in our endeavor, the fruits of the Green Revolution will comprise a harvest richer than we had ever dreamed.

Thank you.

The Heart of the Matter

Presented during the Dinner Meeting with Friends of ICRISAT, 21 October 2001, Hyderabad, Andhra Pradesh, India.

As we start this century, poverty – along with its twisted stepchildren, hunger and inequity – still remains a global problem.

Of the world's 6 billion people, nearly half live on less than 2 dollars a day. Another 1.2 billion live on less than a dollar a day. This is unacceptable.

According to UNDP, 6 out of every 100 infants do not reach their first birthday, and 8 will not survive their fifth. This is unacceptable.

Aside from income and food, technology is also unequally distributed around the world. Technological innovations are developed by only 15% of the world's population. Barely half are able to use them. This is unacceptable.

As our old and cherished friend MS Swaminathan says, "Where hunger rules, peace cannot prevail." Poverty amidst wealth, hunger amidst plenty, inequity amidst privilege – such contradictions are breeding grounds for social discontent.

An infant, when traumatized, can do little to alleviate its anxiety. So in its helplessness it throws a temper tantrum. Though bothersome, such outbursts are harmless because an infant is truly helpless. But when adults feel dispossessed, deprived, or hungry – in other words, helpless – they may express themselves with extreme or violent acts.

And while it is quite natural for us to react to in the same manner, we must identify the source that primarily trigger them – poverty.

The developing world is caught in a vicious cycle of poverty, hunger, and inequity, often resulting in political instability. Violence is frequently born out of shattered societies where hunger and poverty

breed hopelessness and despair – the temper tantrums of helpless adults.

Violence cannot be eradicated by eliminating its more visible sources. Violence will always beget violence. Weapons can be replaced. Institutions that repress helpless people can be rebuilt.

The final solution can only be the eradication of poverty.

Amidst the poverty and hunger prevailing in far too many places, the economic prosperity of rich countries is at an all-time high. Our challenge therefore lies in persuading these countries to intensify their development assistance to build a food-secure, prosperous, and peaceful world for all.

ICRISAT on the Wings of Change: the Chosen Path

Opening Address during the ICRISAT Global Planning Meeting, 28 November – 1 December 2001, Patancheru, Andhra Pradesh, India.

Our Chair of the Governing Board's Program Committee, Dr Don Marshall, Jill, colleagues at ICRISAT, friends, good morning.

Allow me to welcome you to our Global Planning Meeting (GPM) here in Patancheru. As we usually do every year, we are again gathered here for more than four days to look at our milestones, identify new initiatives, thresh out operational constraints, and map out action plans for next year.

However, this year's exercise is different. Further taking off from our mid-year review, we will undertake this in the context of the changes being pursued by the CGIAR in general and the Institute in particular.

That is why I have chosen to title my address as *ICRISAT on the Wings of Change: the Chosen Path.*

The four pillars of reform for CGIAR initially presented during the Mid-Term Meeting in Durban, South Africa have been approved during CGIAR's recent Annual General Meeting in Washington D.C.

These reforms are the:

1. Adoption of a programmatic approach to research planning. The CGIAR will pursue a programmatic approach to research planning and funding to complement existing approaches. It will also formulate and implement Challenge Programs.
2. Creation of an Executive Council. The CGIAR has created an Executive Council that will report to and carry out responsibilities delegated to it by the Group.

3. Transformation of TAC into a Science Council. The creation of the Council will build upon the current strengths of TAC. Likewise, it will learn from the experiences of world class national and international science councils. It will also ensure quality and relevant science in the CGIAR through mechanisms such as peer reviews.
4. Establishment of a System Office. The System Office will formulate a single, integrated communication strategy for coherence and fund raising together with the Centers and Future Harvest.

More popularly known as change design and management, these reforms compel us to abandon the usual way of doing things at the Institute.

Thus, through this address, allow me to look forward to our chosen path of change within ICRISAT.

This chosen path is guided by the CGIAR strategy which is embodied in seven core planks, to:

1. Focus on reduction of poverty, hunger, and malnutrition in developing countries.
2. Bring modern science to bear on difficult productivity and institutional problems.
3. Give highest priority to the research needs of South Asia and Sub-Saharan Africa.
4. Adopt a regional approach to research planning.
5. Diversify and closely integrate its partnerships.
6. Adopt a task force approach to the organization and delivery of CGIAR products and services.
7. Serve as a catalyst, organizer, coordinator, and integrator of global efforts on key opportunities and constraints in agriculture, forestry, and fisheries.

We are very proactive to these changes, and this is the reason why we have mapped out a new vision, mission, and strategy for ICRISAT.

We have also reconfigured our organization and management structure to be more responsive to these changes.

I am very happy to report that our Governing Board is strongly behind us in all our initiatives for change at the Institute.

Concomitant to these are our collective efforts in balancing our budget and rationalizing our staff. Core competencies have been identified based on our new vision and strategy.

Let me emphasize that the super-ordinate reason for all these changes is for us to further enhance our impact in helping and empowering the poor people of the semi-arid tropics of the world.

As we have mentioned in our vision and strategy document, the environment in which ICRISAT operates has changed dramatically over the past 20 years.

Publicly funded agricultural research has declined by over 50% during the past 15 years.

An increasing share of agricultural research and ownership of new technologies has moved to the private sector.

Environmental considerations are being increasingly integrated into international development policy.

Thus, we must steer the Institute to function more effectively and efficiently in this new environment.

We must recognize that increasing productivity in the SAT will be firmly anchored on integrated genetic and natural resource management strategies, accelerated knowledge sharing, and improved delivery systems.

We must also consider that impact can be achieved through strengthened and diversified partnerships, including those with the private sector.

Going back to the fountainhead of our reforms, our new vision to 2010 is *improved well-being of the poor of the semi-arid tropics through agricultural research for impact.*

Our new mission is *to help the poor of the semi-arid tropics through*

Science with a Human Face and partnership-based research and to increase agricultural productivity and food security, reduce poverty, and protect the environment in SAT production systems.

Please note that we are putting impact as the ultimate end of our research programs. Likewise, partnerships and *Science with a Human Face* are our major instruments in reaching this goal.

As part of our strategy, we are actively involved in the planning processes for Challenge Programs on climate change and water and leading on a proposed CP on combating desertification.

We are also actively involved in strengthening regional approaches to planning agricultural research for development in South Asia (where ICRISAT is the focal point), Southern and Eastern Africa, and West and Central Africa.

We will target important problems facing SAT farmers, many of which are also important at the global level. This will be pursued through diversification and integration of partnerships with appropriate stakeholders to include SROs, IARCs, NARIS, development agencies, NGOs, community-based organizations, and the private sector.

As we have agreed in Nairobi, we will adopt an integrated genetic and natural resource management as a framework in pursuing our programs.

At the heart of our research projects are the six global research themes namely:

1. Harnessing biotechnology for the poor.
2. Crop management and utilization for food security and health.
3. Water, soil, and agrobiodiversity management for ecosystem health.
4. Sustainable seed supply systems for productivity.
5. Enhancing crop-livestock productivity and systems diversification.
6. SAT Futures and development pathways.

As you already know, corresponding deliverables have been identified for each of these research themes.

To pursue the foregoing changes, we have reconfigured our organization and management structure. Together with our new vision and strategy, this new set-up was approved by the

Governing Board during its recent meeting here in Patancheru.

The old O&M set up was anchored on four programs namely genetic resource enhancement, natural resource management, information resource management, and socioeconomics and policy.

The new set-up which will take effect on January 01, 2002, is based on a more focused, problem-based and impact-driven research agenda.

Evolutionary in nature, it is essentially flat, lean, and regionalized for greater efficiency, effectiveness, and responsiveness.

The new O&M set-up will have three functional areas directly under the Director General. These are research to be headed by a Deputy Director General, operations to be headed by an Assistant Director General, and finance and human resources under a Director.

The new research structure is based on the six global themes I have mentioned. Each of these will be headed by a Global Theme Coordinator (GTC) who will report directly to the Deputy Director General (DDG) for Research. Each global theme will be addressed by specific regional projects.

Supporting the implementation of the foregoing themes are four units also under the DDG-Research. These are:

1. Impact Assessment Office (IAO) which has the same level as the global themes;
2. Information Resource Management Office (IRMO) which will include Geographic Information Systems;
3. Farm and Engineering Services (FES); and
4. Genebank.

To optimize scarce resources, ICRISAT proposes to consolidate its research operations in four main regions only. These are Asia (Patancheru), Eastern Africa (Nairobi), Southern Africa (Bulawayo), and West and Central Africa (Niamey).

The Regional units will address different sets of global research themes depending on contemporary needs and priorities of the area. Each of the three African locations will be headed by a Regional Representative (RR) who will report directly to the Director General. The RR will essentially serve as the DG's alter ego in his/her area of coverage.

Aside from the overall management of the regional hub, the RR will spearhead public awareness and resource mobilization activities.

Serving to support the Institute especially at the headquarters will be the various service units like Purchase, Supplies and Disposal, Transport, Security, Housing and Food Services, and the Liaison Office in New Delhi.

These service units will be supervised by the Assistant Director General (ADG) for Operations. These units have been clustered under one supervision for greater efficiency and responsiveness.

Complementing the foregoing service units will be Human Resource, Finance, and Locations Administration. These will be supervised by the Director for Finance and Human Resources.

Three vital support systems will be operating under the Office of the DG. These are: Public Awareness Office, Resource Mobilization Office, and Internal Audit.

I will be announcing the complete line up of appointments in our new O&M on Saturday during the Global Coordination Meeting.

With our new vision, mission, strategy, and global research themes, we are now in a position to move forward to our chosen path towards change.

It is in this context that I would like to view our global planning meeting. Our primary business in this exercise is to identify more focused research priorities and translate these into impact-oriented operational research projects and activities of global and regional dimensions, driven by the six global themes.

During this meeting, I would like to encourage you to refocus your perspectives to the aforementioned changes, priorities, think new, and not recycle the same old things. Attitudes have to be changed to embrace change itself. The business as usual attitude is no longer relevant today and in the future.

We should approach this with urgency, since this will determine our impact on the livelihoods of the SAT poor, and attract development donors/investors.

Beyond all of these, let me again reiterate the need to always put a human dimension to our new research projects and activities.

To do this, we must always use *Science with a Human Face* as the guiding light in this meeting.

We must remember that ICRISAT is an organization that serves poor people first and foremost.

Science is a means that we use to serve the poor, not an end in itself.

Even if we do excellent research, if we do not make an impact in improving the lives of the poor, we have failed.

Only by using science to help reduce poverty, malnutrition, and environmental degradation can we say that we have made an impact in the lives of the poor.

Beyond producing quality and cutting edge science, our work at ICRISAT, in cooperation with our partners, should benefit the most marginalized, disadvantaged, and hungry.

As we pursue our chosen path for change, let me again reiterate my vision for ICRISAT in the immediate future.

I foresee that ICRISAT will be the world class genetic and natural resources management-based research institute for dryland agriculture, complemented by our work in the social sciences and knowledge sharing.

Let us therefore work together and work much harder with a renewed commitment in pursuing this chosen path to address new issues and problems of hunger, poverty, and development in the dry areas of the world.

Thank you and good morning.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, apolitical, international organization for science-based agricultural development. Established in 1972, it is one of 16 Future Harvest Centers, and is supported by more than 50 governments, foundations, and development banks called the Consultative Group on International Agricultural Research (CGIAR).

ICRISAT focuses on the semi-arid tropics, home to one-sixth of the world's population. Persistent drought, unpredictable weather, limited and erratic rainfall, and nutrient-poor soils are the farmer's challenges.

ICRISAT's mission is to help developing countries in the SAT increase crop productivity and food security, reduce poverty, protect the environment through partnership-based research with National Agricultural Research Systems (NARS), Advanced Research Institutes (ARIs), Non-Governmental Organizations (NGOs), the private sector, networks, and other CGIAR centers.

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