manner – we will have reestablished our relevance for the new millennium. If we do that, I am confident that the donors will return to us with enthusiasm.

How does this new vision of ICRISAT's role differ from what we have been doing in the past? This new paradigm must still continue to be built on a core of scientific competence. Without that competence we would lose our credibility, and our capability to recognize and capitalize on opportunities unseen by others. But that is not enough any more. It is essential, but not sufficient.

The bridge, broker, catalyst paradigm means that scientists will have to develop stronger partnership-building skills in addition to their scientific credentials. You will have to build your research initiatives from the start with a clear idea of how our comparative advantages and or competitive edge will be exercised throughout the course of the project cycle. You will need to become adept at recognizing the differing strengths and weaknesses of different partners, and convincing them that the greatest strength lies in working together and learning from each other. You will need to learn how to identify and show partners that there are win-win solutions to difficult conflicts of interest. And you will need to develop a keen eye for new opportunities that can catalyze the excitement of both research partners and donors.

These partnership skills were not the ones taught to most of us when we carried out our degrees. They were probably not considered as a high priority even in the early days of ICRISAT. So it is understandable if they represent a new challenge to many of us. But we must face and overcome this challenge if we are to exploit our Institute's innate comparative advantages and or competitive edge, and remain relevant and important in the eyes of our stakeholders in the coming years.

Some of these skills can be enhanced through specialized training. I am asking our Human Resources Division to suggest some options in this regard. But to a large extent, we have to learn these skills by doing, and by learning from those colleagues who have already become highly effective bridges, brokers, and catalysts.

I would ask that you all reflect on this paradigm, and ask yourselves how we can put it into practice in our planning efforts this week. Please note that we will revisit these issues in a Vision/Mandate discussion session on Sunday afternoon. I believe it is essential that we all carry a common understanding and put to heart our Institute's vision, mission and research strategy.

In addition to our external partnerships, I also want to reiterate the importance of partnership approaches within ICRISAT. I know you are all aware of this need and have purposely designed certain Center Projects around cross-Program themes. Now we need to implement this goal through our specific, concrete workplans. I will observe this process with great interest during the week.

Another comment I would like to make on the process of workplanning, is on our degree of focus and targeting. Do we have a clear and a shared definition of what constitutes the

Bringing *Science with a Human Face* to the Semi-Arid Tropics

A Compendium of Speeches and Presentations by

William D. Dar

January-December 2000

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

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our competitive edge? We must have not only a good, but an excellent, answer to this question if we are to re-create this Center in the new millennium.

Recently, the Research Management Committee deliberated this issue for another purpose. We were asked to contribute ideas on this topic to the Technical Advisory Committee (TAC) of the CGIAR. The purpose is the reassessment of the Vision of the CGIAR. This Vision process, which is a follow up from the Systemwide Review, is an important one, and I will come back to it later. The Research Management Committee suggested a Vision of an ICRISAT that transforms itself to focus more squarely on our comparative advantages as an international, nonprofit, scientific organization and I will add to that, what's ICRISAT competitive edge in the global agricultural research system. That model is summarized in three prime roles: bridge, broker, and catalyst.

Allow me to briefly describe these three roles.

As a "bridge", we apply the comparative advantage and or competitive edge of our international character to facilitate international transfers of research skills, information, and technology, for example from developed to developing countries. Biotechnology and GIS are obvious examples of transfers from developed to developing countries, and our crop networks are well-known south-south transfer mechanisms. I'm sure you can think of many other cases in which we are functioning as an extremely valuable bridge. It is difficult to think of any other institution in the world better placed to carry out this role, within the domain of agricultural research for the semi-arid tropics.

In our "broker" role, we facilitate exchanges of germplasm, research information and other technologies. Our neutral and international constitution is our unique comparative advantage and/or competitive edge in this role. Our various national, private, developed, and developing-world partners trust that we will be an impartial broker where bargains need to be struck. Examples include germplasm transfers in the context of intellectual property rights issues, and tradeoffs of natural resource management assets between communities and regions. One major example of which we are all aware is the agreement with FAO that we should become mankind's guardian for some of the world's most precious biological resources, our gene banks.

Last but certainly not least, in our "catalyst" role, we take advantage of our unique combination of research skills, first-class infrastructure and global partnerships to catalyze important new research thrusts addressing serious global problems and opportunities that are beyond the remit or capacities of national and local institutions. Here we can certainly cite our desert margins initiative, our pearl millet molecular marker research, and our catalytic role in extending the benefits of modern pigeonpea germplasm and processing techniques to Africa, among many other examples.

I believe that if we can clearly establish the critical nature of these three roles in helping developing countries, particularly in the semi-arid tropics, to build a better tomorrow – and if we can convince the world that we are the institution uniquely positioned and having the competitive edge to carry out these roles in the most sustainable and effective

Workplanning Meeting Week

Welcome Address
19 January 2000

Good morning/Namaskar/Bonjour:

First of all it is my pleasure to welcome you all to ICRISAT's Annual Workplanning Week. This will provide us with an excellent opportunity to determine the concrete steps we will take this year on the road to building tomorrow together, doing science with a human face. I look forward to excellent and thought provoking discussions, and to meeting those of you whom I have not already gotten to know yet.

I wanted especially to join ICRISAT in time for this event, because it focuses on our research-for-development agenda, which is the heart of our mission as an Institute. Of course I have much to learn, and will take this opportunity mainly to listen and observe. It is too early for me to comment on many specifics of the research agenda, which I presume is anchored in the new ICRISAT vision and mission and guided by a very competitive global environment. This morning, I will simply raise a few key institutional issues which have a direct effect on that agenda.

And as you know, we are in the process of recruitment to fill our DDG position, which will be responsible for close oversight of that agenda. The present plan is for interviews to be held in late March, and a decision to be taken around the middle of April. Meanwhile I am confident that your Directors, and the Research Management Committee in which I am involved, will provide wise leadership and counsel.

In my meetings prior to joining ICRISAT, as well as in my many interactions with partners and stakeholders as a Board Member, one issue comes up time and time again. Everyone is very concerned that core donor support has been falling for almost a decade now. Donors' attention has turned to other priorities. Some point out the food glut that exists in many parts of the world. Others suggest that the private sector and national institutions can replace the CGIAR. Some are asking whether there is still a need for us at all.

In my initial address to staff, I emphasized the need to focus our work on the human face of poverty. If we can articulate how our work helps transform the lines of worry and fatigue written on those faces into expressions of hope and optimism, I believe we can convince donors to renew their commitment to our shared mission. We must prove that we are relevant, competitive, and that what we do makes a difference in the lives of the poor and the hungry. Beyond just improving crops and farming systems, we must improve livelihoods.

What can we offer our clients and stakeholders that is compelling, and which no one else can do, or do nearly as well in alleviating poverty, hunger, and environmental degradation? In other words, what is our relevance, our comparative advantage and

William D. Dar
*Biographical Sketch**

William Dollente Dar was born in the town of Santa Maria in the province of Ilocos Sur, Philippines, in a smallholder farming family to Marcelo and Ana Dar on 10 April 1953, and became the youngest Director General of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), when he took charge at the Institute headquarters in India on 11 January 2000.

William Dar grew up helping his parents and family cultivate rice and vegetables. This was besides his schooling, which he started in 1959 at the Elementary, Sta. Maria West Central School in Sur. At the early age of 12 he entered the High School at the Ilocos SurAgricultural College, and was Valedictorian by the time he finished in 1969.

William Dar obtained his B.S and M.S. degrees from the Mountain State Agricultural College, now Benguet State University (BSU), La Trinidad, Benguet, before moving on to the University of the Philippines at Los Baños College, Laguna, where he was awarded a Ph.D. in Horticulture after working on his dissertation from 1977 to 1980, and while he was Assistant Professor at BSU from 1979 to 1981.

In 1987, Dr. Dar helped set up the Bureau of Agricultural Research of the Philippine Department of Agriculture, and, as its first Director, led it through its first seven years. He led the formulation of the National Agricultural Research and Extension Agenda, and the rationalization of the agricultural research system of the country. In 1994 he became Executive Director of the Los Baños-based Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD), which is the apex agricultural research institution of the country.

Culminating the steep and steady rise in William Dar's career, President Estrada of the Philippines appointed him as Acting Secretary of the Department of Agriculture (equivalent to the Minister of Agriculture) in 1998, and Presidential Advisor on Rural Development in the Philippines in August 1999.

**As of January 2001*

Dr. Dar is the recipient of many awards, plaques of recognition, and plaques of appreciation. He received the most coveted Ten Outstanding Young Men (TOYM) award in 1988 given by the Philippine Jaycees. He is a member of several professional societies (in capacities of Vice-president and President for some), has published works to his credit, and has conducted noteworthy Research and Development works.

His greatest contribution to agriculture was during his tenure in the Department of Agriculture where he worked unstintingly for rural development and the uplift of Filipino farmers and fisherfolk. Under his stewardship the agriculture sector gained a positive 2.7% growth, with rice and corn registering 35% and 62% growth respectively, the highest in six years. He also served as the Chair of the Asia-Pacific Association of Agricultural Research Institutions (APAARI), and represented the region in the establishment of the Global Forum on Agricultural Research (GFAR), an initiative of the Consultative Group on International Agricultural Research (CGIAR).

William Dar was no stranger to ICRISAT when he became the Director General of the Institute. He served as a member of the ICRISAT Governing Board from January 1997 to September 1999. ICRISAT is headquartered in India with research centers in Sub-Saharan Africa. He was a member of other Boards of Trustees including the International Center for the Improvement of Maize and Wheat (CIMMYT), and the Australian Centre for International Agricultural Research (ACIAR). Earlier he was a member of the Oversight Committee of the CGIAR.

In just one year of directorship at ICRISAT William Dar has brought about significant changes at the Institute. The most compelling change is the renewed awareness among the staff that the scientific research we perform must eventually benefit humankind. Thus, **'Science with a Human Face'** has become ICRISAT's mantra. ICRISAT's research agenda has been strengthened and consolidated, and has become more focused. The Institute's vision and strategy has been enhanced and aligned with the new CGIAR vision. Collaborative efforts involving the private sector, and NGOs have increased dramatically. Joint project formulation and fund generation with strategic partners resulted in significant increase in funds. ICRISAT's information and publication activities were modernized. Improvements in physical facilities created a better working environment. Last but not least, Dr. Dar has made structural changes in management and administration, which boosted staff morale immensely.

Dr. Dar is married to Beatriz Meria Dar, a forester, and together they had four children, May, William Jr. (deceased), Celeste, and Christine.

ICRISAT will have to face up to some financial shortages and other challenges in 2000. The Governing Board allowed some draw down from our reserves to ensure stability in 2000. We have to use the year 2000 to create a stronger ICRISAT, which will hopefully result in obtaining more funds in 2001 and beyond. This is the responsibility of each one of us. Therefore in 2000, we will not resort to any downsizing. However, it means that we will have to contain many of our expenses, tighten our belts, and make whatever savings we can. The first allocation of budget in 2000 has already reduced operating funds by 20% to balance the budget. This was a result of the withdrawal of committed funds for 99 by the EC. Therefore, we need to move carefully. This is where the staff council has to understand realities, play the essential role of coming up with practical solutions, and explain them to staff.

We have an enormous task ahead of all of us to improve ICRISAT's image. We have to sit down and sort out our own problems. In the past, there has been a tendency to make complaints and petitions to Board members and other visitors. I have seen this from the other side. To some extent, this has contributed to the creation of a negative image for ICRISAT outside including with donors. Solving of internal problems is the business of management with your support.

Finally I would stress the need to form a healthy family and community environment where issues are discussed openly based on trust and agreed solutions found. We also need to bring ICRISAT staff members and families together through various interest groups and social activities. I would like you to come up with good suggestions and take the lead in this area.

None of these can be achieved without the full support of all staff. The Staff Council has this major responsibility for the betterment of the Institute.

There is a new delegation of authority, which has been issued by Dr.Swindale in December. This strengthens the Office of N P Rajasekharan and the HR team to deal with staff matters. I expect most if not all the problems to be solved by you with Human Resources. That is not to mean that you have no access to me. I will walk around and be in touch with you. I follow an open-door policy and you are free to meet me if required. That mode of problem solving will be very exceptional.

Let us make the Year 2000 a year of stability. Let us build tomorrow together. Each one of us has a role to play and the Staff Council has probably one of the biggest roles to play in the rejuvenation and re-vitalization of ICRISAT. You have my full support and I wish you all success. I now formally declare this workshop open.

Workshop for the Staff Council

Inaugural Address

13 & 14 January 2000

I am pleased to welcome the new Staff Council members into the new millennium – both the elected staff representatives and the new Management nominees. Let us make new beginnings. I am also very pleased that a 2-day orientation and training workshop has been organized. We are all working to achieve the same objectives doing science and research for development that would lead to poverty reduction, food security, and environmental sustainability in the semi-arid tropics particularly for the marginalized, the disadvantaged, and the hungry. Let us work and learn together and start this challenging journey together.

As a Governing Board Member then, I have seen the staff council of the past perform. Often it was in a confrontational manner. We cannot afford to continue in that mode. I look forward to all of you working together to find optimum solutions and to solve problems in time. Always we have to create a win-win situation.

As the new DG I will give due importance to the role of the Staff Council. We need to build this institution together and we can enhance this if there is peace, harmony and unity.

The new personnel policy manual was approved by the Governing Board in September 1998. The role of the Staff representative bodies is clearly defined in it. Let me read from the policy, which provides the clear framework. This was developed in full consultation with staff at all locations. Accordingly, the role of the Staff Council has to be re-defined.

Quote

Clause 2.7 Staff Members' Associations

2.7.1 ICRISAT encourages mechanisms through which it may be appraised of staff members' ideas and suggestions about the direction and operation of the center, of which they are an important part. Such mechanisms also permit staff members to bring to the DG's attention, in an orderly fashion, problems and concerns that affect working conditions of staff members.

2.7.2 While democratic in design and nature, staff associations do not share DG's decision-making role but play an important advisory role

2.7.3 The staff associations would however be considered as those duly recognized by the Director General who shall have the right to derecognize if situation so warrants in the best interest of the Institute.

Unquote

Foreword

I am delighted and honored to contribute this foreword to the compendium of speeches and presentations by Dr. William D. Dar during the year 2000, his first year in office.

The compendium is not just a record of messages delivered on a wide range of topics to a wide spectrum of audiences, but is a wealth of information about the vision, mission, and scientific work of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), of which Willie Dar is the Director General. Running like a golden thread through all the presentations is the theme "Science with a Human Face", ICRISAT's mantra, continually reminding one that the scientific work carried out at the Institute is not for science alone, but ultimately for human benefit, for both current and future generations.

I fully recommend this compendium to all Institutes, Universities, Government and non-Government bodies, and all people of similar mind who participate in scientific research for development.

Ragnhild Sohlberg
Chair
Governing Board of ICRISAT

You all know the implications of this announcement, in terms of both financial viability and program sustainability not only for ICRISAT but also for the whole CG system. On the other side, we must work harder to get the support of the CGIAR and other stakeholders for the continuation of ICRISAT into this new millennium. We must prove, and I believe that ICRISAT has a big role to play particularly to the poor communities in the agro-ecological regions, that we serve.

While seemingly daunting, the withdrawal of EU support at the close of the year, without warning or foreboding, is clearly a wake-up call to strengthen the CG system. With uncharted tasks and unknown threats that await us in the new millennium, there is a compelling need to consolidate and recreate the CGIAR, and ICRISAT as a CG center. We must all be part of this revitalization in a proactive manner.

I am sure more challenges are still before us. But I have confidence in you, in ICRISAT, not just as a premier international research institution, but as a family and as a community. With a sense of urgency, resilience and creativity, governed by a heart for the people we serve, I know that we shall be able to prevail.

With humility, I therefore accept wholeheartedly the honor and responsibility of serving ICRISAT as Director General, hopefully for the next five years.

To the Search Committee, thank you for your confidence in me. And to ICRISAT Chair, Dr. Ragnhild Sohlberg, to Interim Director General, Dr. Les Swindale, to the members of the Board of Trustees, to ADG S. Parthasarathy, to the Program and Service Directors, and to all the ICRISAT staff, thank you for making it easy for me to come in and take over the helm as Director General.

The greater honor for me, however, is to be part of this community and a member of this family, committed to serve the poor and the hungry of this planet.

In the next five years, it is my earnest hope that as Director General, I shall be able to steer ICRISAT toward greater growth and stability. With all of us working together as a team, with our collective effort, I envision that ICRISAT shall play a key role in eradicating hunger, reducing poverty, and safeguarding the environment in the African and Asian semi-arid tropics.

As we fulfill this role, we shall come much closer to our common and shared dream of a prosperous, sustainable, and food secure world particularly of the semi-arid tropics.

Thank you all.

dedicated yourselves to the vision, culture, programs and activities of the Institution. ICRISAT and the rest of CGIAR system are very proud of you.

As a family, this will be our first experience of living out of the Philippines. For my wife and me, and two younger daughters, this will be our first separation from our eldest daughter and her husband who are now the proud parents of our first grandson.

I am sure you know what I speak of, for some, if not many, of you may be in similar circumstances. And as in Indian society, the family in the Philippines is closely-knit and plays a pivotal role in our national life.

With such a comparable cultural backdrop, my family and I eagerly settle into our new home in this colorful continent that is India. At the same time, we are glad to be welcomed not by strangers but by the ICRISAT family.

That ICRISAT, here in Asia or in Africa, is not just a work locale or duty station, but a family and a community, is most reassuring. Not just for my family and me, but more importantly, for the constituents ICRISAT is committed to serve – the poor and the food insecure people of the semi-arid tropics.

Beyond producing quality and cutting edge science or relevant research, the work that ICRISAT does, in cooperation with our partners, must benefit most the marginalized, the disadvantaged, and the hungry. This is the human face of the science and the agricultural research that we do. This must be the overarching theme of our efforts, the paramount motive of our endeavors.

Specifically, the agricultural research we undertake must not just generate greater and better knowledge about crop genes, production systems and environmental management. It must also result in increased income opportunities for farmers and an improved quality of life among farming households in the semi-arid tropics of Africa and Asia. At this point, I would like to see the accelerated implementation of the 14 center projects, but we just need to further focus/sharpen the various operational projects and activities. Likewise, we will pursue more investments and visibility of ICRISAT in sub-Saharan Africa. We are now working together with other CGIAR centers and the NARS in the region to formulate a new agricultural research strategy for Africa.

Thus, if we are to realize our vision for the poor and the hungry, if we are to succeed in our mission, we must start at home, right here and the other areas where we work. ICRISAT, too, has a human face. It is family, it is community, and herein lies our strength.

With the new millennium having dawned on us, ICRISAT is faced with fresh and greater challenges. Among the realities that have recently emerged is the default that was announced in mid-December by the European Union on its 1999 commitments to CGIAR.

Contents

Serving with a Heart

Inaugural Address to ICRISAT Staff on Assuming Office of the Director General

ICRISAT-Patancheru
12 January 2000

Namaskar / Bonjour
I am overwhelmed by the warmth and generosity of your welcome, since I arrived here two days ago. On behalf of my wife and children, who will soon follow, I would like to thank you for the comforting assurance that we are at home here.

At this point, I would like to express my thanks and appreciation to the following:

To the Governing Board with Dr. Ragnhild Sohlberg as Chair for giving me their trust and confidence and this opportunity to serve ICRISAT as its first Director General in this new millennium.

To Dr. Les D. Swindale who served as Interim Director General of ICRISAT for being able to restore a sense of purpose and the morale of staff including other innovations he has introduced in ICRISAT. We will never forget Les for the outstanding job he has done for ICRISAT all his life.

To ADG S. Parthasarathy for ably taking charge of the Institute after Dr. Les Swindale departed. Partha met with me in New Delhi and briefed me of the latest developments and happenings in ICRISAT. I am very much touched by this gesture.

To the other officials, the scientists, the other men and women of this prestigious institute for having worked continuously and enthusiastically and for having committed and

Brainstorming Session on Desertification in India

Welcome Address
ICRISAT-Patancheru
8-9 June 2000

Good morning to you all. I am very pleased to welcome you all at ICRISAT to participate in an important meeting dealing with desertification. Our special welcome to Dr. James Morton, Consultant, NRSP, DFID, UK who is attending this meeting. Our friends from ICAR, we are happy to have you here representing important national research institutes as well as friends from the universities of India and an important donor agency such as DFID. Some of you are visiting ICRISAT for the first time and we wish that this association between us will become stronger and we all will collectively be in a better position to tackle the problem of desertification in the semi-arid (SAT).

At this point let me mention the new CGIAR Vision and Strategy adopted at MTM 2000.

VISION: A food secure world for all.

GOAL: To reduce poverty, hunger, and malnutrition by sustainably increasing the productivity of resources in agriculture, forestry, and fisheries.

MISSION: To achieve sustainable food security and reduce poverty in developing countries through scientific research and research-related activities in the fields of agriculture, forestry, fisheries, policy, and environment.

STRATEGY: It is comprised of seven elements namely:

Sharply focus its activities on the reduction of poverty, hunger, and malnutrition in developing countries;

Take vigorous steps to bring modern science to bear on difficult productivity and institutional problems that have proven intractable in the past;

Give highest priority to developing a concerted approach to address the research needs of South Asia and sub-Saharan Africa where poverty is concentrated and growing, and major impacts can be made via technological breakthroughs in productivity and ensuring the sustainability of natural resources;

Adopt a regional approach to research planning in order to better address the heterogeneous nature of poverty;

Diversify and closely integrate its partnerships at the regional level to ensure that modern science is brought to bear on the problems of the poor efficiently and effectively;

SAT, and where the poorest peoples are located within it? Are we confident that our plans are most directly addressed to their needs? I am glad to see that as part of Project S2, now renamed P13 for the year 2000, we will be attempting to gain a clearer understanding of the clients we serve and the potentials of the environments they live in. I will be very interested in following the development of this Project.

In parallel with the development of Center Projects, I am also pleased to learn that a consolidated agenda for our efforts in Africa is in the works, based on our Board-approved strategy and the CGIAR Africa coordination initiative. Your Directors will discuss the specifics of this crucial initiative with you over the course of this week. We have been fragmented in our approach to that continent for too long. I am confident that our core donors will be enthused about a coherent, strategic agenda for the continent. This issue will be discussed further in a plenary session on Sunday.

Returning now to the issue of the CGIAR Vision – it is clear that the entire System is as concerned as we are about our collective relevance for the longer term. There is a sense of urgency, and a consensus that change is needed – that business as usual will not be good enough. Next Monday, just after the completion of the wrap-up plenary session of our meeting, I will go to Rome to meet with the Center Directors to deliberate our collective position on the new System Vision. Major decisions about reorientation and even re-creation of the System will be seriously discussed during the Mid-Term Meeting in May and Centers Week in October.

I hope to pick up good ideas from you this week that I can carry with me to contribute to the discussion there. And I hope you will discover some new ideas and approaches this week as you ask yourselves how you might become a more effective bridge, broker, and catalyst for ICRISAT.

I would like now to turn to the specifics of our funding strategy. As you know, the overall trend in recent years has been for donors to increase restricted support, while decreasing unrestricted support. We will have to work much harder to increase unrestricted funds to support long-term strategic research projects of the Institute. I plan to visit Australia, Japan and IFAD's headquarters in Rome in the coming months, and Germany for the mid-term meetings.

As I make this effort, I will need your help to ensure that we make best use of the funds we have, and do not undermine our relationships with the donors through inadequate management of their grants. I understand there are a number of cases where we did not utilize the funds we worked so hard to obtain, and had to either return them or ask for extensions of the project. This sends the wrong signal, and can have long-term implications for our relationship. If this is happening today, this cannot continue.

A related issue is the need to build in the full costs of project work into our proposals, including staff costs and overhead costs, in addition to all line item expenses. Staff should not offer discounts to the required overhead during their discussions with donors. This brings a hidden liability to the Institute, draining our precious and declining core

unrestricted funds. Any exceptions must be discussed with myself and Donor Relations before any suggestion is made to the donor.

Our strategy for revitalizing donor support has to be built on improving the appreciation for our work within the donor and stakeholder community. This is not just the job of our PA unit or myself. We all have to become persuasive salespeople for the Institute, competing sustainably, because we all interact with stakeholders and clients in the course of our work. It will no longer be sufficient to put on blinders and only take interest in our own activities. Each of us will need to acquire a broad understanding of the Institute's overall vision and research agenda, impacts and promising technologies coming through the pipeline. I would like to draw your attention to a Public Awareness Advisory meeting on Monday afternoon, where I invite you to participate with PA staff in brainstorming more ideas on this.

Finally, a comment on the immediate issue of our year 2000 budget. You are all aware that the European Union has been unable to fulfill its promise of its 1999 unrestricted funds contribution, which puts us in a difficult financial position again. Despite this set-back, I am determined that the first year of the new millennium will be one of stability and confidence for all our staff community. Therefore we will manage this shortfall by tightening our belts, not by downsizing. To meet this objective, we will all need to do our work with a great deal of cost-consciousness this year. Please keep this in mind as you plan your specific activities. Please build your work plans such that they use our restricted funds to the maximum, while conserving unrestricted funds as much as possible.

With that, I will close for now. I would like to thank the Program and Division Directors, the RMC and Logistical Arrangements Committee, and the support staff who have prepared long and hard for this meeting. I am confident that their efforts will make it possible for us all to have a very pleasant, creative and stimulating Workplanning Week.

We at ICRISAT are working relentlessly to ensure increased agricultural production in the SAT through enhanced conservation of rainwater and increasing its efficiency through adopting a holistic watershed management approach. Our partners in this difficult task are NARS institutes such as CRIDA and other ICAR institutes, state agricultural universities, NGOs and farmers. I am quite confident that we, all together, can contribute significantly towards fulfilling the noble mission of harvesting maximum rainwater which the Honorable Chief Minister Mr. Naidu has started earnestly. I want to stress the fact that the ultimate goal of our work is to help the poor and needy farmers in the SAT who are struggling to survive and face the wrath of the harsh environment. Our real stake-holders are these resource-poor farmers and through our endeavor, in partnership with the farmers and NARS institutes, we will bring a smile on their faces in the near future guided by our motto of doing Science with a Human Face. Once again, I wish you all very productive and fruitful deliberations during the day and let me reaffirm ICRISAT's sincere commitment to contribute our bests to this noble mission for the benefit of millions of poor people.

I wish you all a fruitful and productive visit to ICRISAT.

Thank you.

Training Course on Rainwater Harvesting

Inaugural Address
15 May 2000

Ladies and Gentlemen,
Good morning to you all.

I am very pleased to welcome you all to our institute, the International Crops Research Institute for the Semi-Arid Tropics popularly referred to as ICRISAT. Some of you may be visiting this institute for the first time and I am personally very happy for your visit to us as you are active partners in the very noble mission of harvesting rainwater which is launched by the Honorable Chief Minister of Andhra Pradesh Mr. Chandra Babu Naidu. You must be aware that this is an important part of our mission of improving the livelihoods of the millions of resource- poor farmers who live in the semi-arid tropics (SAT) through increasing the productivity of rainfed agriculture through the development of improved high yielding crop varieties and improved and efficient management of natural resources.

Currently, millions of poor people are suffering due to the severe drought prevalent in some parts of India including Andhra Pradesh. The main source of water for crops, human beings and animals in the SAT is from the seasonal rainfall which is erratic and affects the livelihood of millions of poor people. For ensuring increased productivity of agriculture and availability of water, the rainwater must be conserved and used most efficiently in the SAT.

We at ICRISAT have lot of long-term data sets on water balance in the SAT areas which indicate that only 30 to 60 per cent of rainfall is used for crop production and a large proportion (40 to 70 percent) of rainwater is lost as runoff. Our long experience of 27 years in the area of watershed management has clearly showed that the rainfall use efficiency for crop production can be increased up to 70 percent if rainwater is managed properly by adopting an integrated watershed management approach. Our basic strategy is to conserve rainfall in the community watersheds where it falls and efficient utilisation of natural resources such as water, soil, and vegetation in the watershed to increase the system's productivity and mitigate the adverse effects of natural calamities such as excess rains or severe droughts.

My colleagues (Dr. Wani and Mr. Bisht) will take you around the institute and share our experiences in the area on how we are harvesting and managing rainwater from 1400 ha land for fulfilling most of the water requirements from internal resources and also contributing to protect the environment through increased greenery in the campus. Increased greenery also contributes significantly to reduce atmospheric concentration of carbon dioxide which is one of the "Greenhouse" gases contributing to global warming.

Partnership Day

At ICRISAT–Bamako, Mali
18 February 2000

Your Excellencies, Your Excellency Minister for Rural Development and Water, Government of Mali,

Members of the ICRISAT Governing Board,
Chairpersons of CORAF and CNRA,
Representatives of CGIAR Centers,
Friends from the donor community,
supporters and colleagues :

Good morning, and welcome to ICRISAT. This is a special day for ICRISAT. I am grateful to all of you for sparing your valuable time to join us on this important occasion.

Today we can reflect on our accomplishments over the past 27 years in Africa, which has ranged from the success of the pearl millet selection Okashana 1 in Namibia to helping Eritrea rebuild its agricultural economy by strengthening its sorghum crops. In eastern and southern Africa, ICRISAT helped to popularize the cultivation of pigeonpea, while in the west, ICRISAT sorghum varieties made slow but definite impact avoiding drought, pests and other yield reducers such as *Striga* and so did groundnut varieties that were resistant to the dreaded rosette virus disease.

There is good reason to be both proud and humble. It is with pride that we take note of what we have achieved together on all these fronts in agricultural research for the poor who inhabit the semi-arid tropics. We could not change the climate but we could change what the farmers grew and how they grew their crops. However, it is with considerable humility that we note that what ICRISAT achieved over more than two decades could never have been accomplished without the support and collaboration of national agricultural systems. In Mali, it has been IER; in India, it has been ICAR; in Zimbabwe, it has been the DR&SS and so on. The list is endless. It is these national institutions that have tested our technologies and released our varieties and hybrids. I know very well the role of such institutions in furthering the work of the international agricultural research centers, as I have led a similar one PCARRD in the Philippines. The agricultural universities in Nigeria, India, Kenya, and Zimbabwe among others have provided a crucial role in extension and human resource development, and in recent years the NGOs and private sector have added their mite to strengthen the links that add to this chain of development. The regional bodies such as SACCAR, ASARECA, CORAF, FARA, APAARI, INSAH, etc., ensured that centers like ICRISAT could benefit entire regions and not merely a few privileged countries within the regions of the semi-arid tropics. Again I speak with experience of having worked closely with APAARI. ICRISAT could not have achieved anything if there was a weak link in the partnership chain.

ICRISAT must sustain its scientific growth, to be able to continue to advance our knowledge of semi-arid tropics, its crops and its natural resources. These are the necessary building blocks for the development of this challenging zone, where more than 800 million people live under harsh production conditions – where soils are poor, water scarce, and support for research and development institutions limited. Africa faces major challenges in increasing agricultural productivity to achieve food security, higher rural incomes and sustainable growth while maintaining and improving the natural resource base. Over past decades, the annual 2-3% growth in agricultural production in Africa has been outdone by the increase in human population, and this disparity has brought hunger, poverty and environmental degradation.

The entire CGIAR system is working to increase the coherence, partnership-orientation, relevance and effectiveness of the CGIAR's work in Africa. The goal of the renewed CGIAR is to conduct research with its partners; research that will help liberate the deprived and disadvantaged from the grip of extreme poverty and hunger. The central themes of the CGIAR vision are: less poverty; healthier, better- nourished families; reduced pressure on fragile natural resources; and people-centered policies for sustainable development. The emphasis is now focusing on the links between poverty, productivity and natural resources, with poverty alleviation as the guiding impulse. How can we achieve this laudable goal in the difficult semi-arid tropics?

ICRISAT is convinced that the vast semi-arid tropical agro-ecosystem — the most extensive agro-ecosystem on the continent — has the natural and human resource base needed to become a sustainably-productive breadbasket. The semi-arid tropics can transform into an export earnings generator. It could even "export" to other agro-ecosystems and urban centers within the same country or region. This would go a long way to reduce poverty and food insecurity for the millions of poor that inhabit the agro-ecosystem. But achieving this rosy future will require substantial progress in technologies, and changes in policies, institutions, and infrastructure.

Taken together, the coarse grains (sorghum and millet) are West Africa's dominant indigenous cereal crops, accounting for almost 60% of total grain production and about half of daily caloric intake, and a third of dietary protein in the SAT zone. They are also major factors in household budgets. Households in rural Africa spend at least two-thirds of their consumption budgets on food, and the percentage increases for poorer families. Studies indicate that most African smallholders in the SAT do not produce enough of these crops to meet their household requirements, forcing to either spend scarce cash or to do without, a clear situation of food insecurity. Although the areas sown to these crops across sub-Saharan Africa have been expanding by about 3% annually since the 1960s, yields have been declining by about 1%. This is largely due to reduced fallowing and expansion of cultivated area onto more marginal lands, compelled by the pressures of population growth.

One of ICRISAT's unique advantages is its global experience in both the Asian and African SAT. A number of analogies can be drawn in the types of constraints and

Environment / Natural Resources

Such a rapid expansion of population is resulting in heavy pressure on the carrying capacity of the semi-arid tropical ecosystems. The distress signals are already evident (e.g., recent extensive flood damage in Mozambique, Zimbabwe and Bangladesh). The climate change in SAT ecologies is threatening food supplies and aquifer depletion. A recent study suggests that in India, recent growth in food production and population has led to unsustainable use of water. Nation-wide withdrawals of underground water are at least double of the rate of recharge and water tables are falling by one to three meters per year. IWMI estimates that as India's aquifers get depleted, its grain harvest could fall by as much as one-fifth (some 20 million t per year).

How to tackle these challenges?

ICRISAT's new vision is built on the overarching objective of poverty reduction – putting a human face on science, with a focus on improving the livelihoods of the poorest of the poor.

This is an ambitious aspiration involving many organizations, and in defining ICRISAT's role within the larger institutional environment, the vision aligns the Institute with its comparative advantages as an international, nonprofit, apolitical organization, specifying that advantage in three terms: bridge, broker, and catalyst. As a *bridge*, ICRISAT takes advantage of its internationality and scientific expertise to foster north-south and south-south exchanges of technology, information and skills. ICRISAT's advantage as a *broker* reflects its apolitical and nonprofit orientation, which engenders trust among partners in exchanges of research products in cases where tradeoffs are required or perceived (e.g., germplasm and intellectual property). The *catalyst* role stems from ICRISAT's scientific expertise and global view, enabling it to convene international partnerships to tackle major research problems/opportunities that would have been too difficult and costly for any organization to handle alone.

In emphasizing science with a human face and the bridge, broker, catalyst roles, the new vision portrays an outward-looking ICRISAT, closely engaged with partners, focused on the relevance and impact of its work, and strongly biased towards the needs of the poor and marginalized rural peoples of the semi-arid tropics.

Conclusion

It is a challenge for ICRISAT to help provide food security in the semi-arid tropics. My staff and I have accepted the challenge. You should also take up the challenge to help the poor and the hungry in this country as well as protect our environment. As you graduate and go for further studies, you need to realize that there are millions of poor in this world battling to survive and I hope that you will develop that missionary zeal to work for the less fortunate members of society and the world.

such diverse societies as those of the Nile, Niger, Senegal, and Indo-Gangetic river basins; the Abyssinian plateau (Ethiopia) and Deccan plateau (India); and parts of the Caribbean islands and Central American isthmus.

Why, it is sometimes asked, do farmers even attempt to make a living in these harsh areas? One could equally ask why wheat farmers try to survive on the dry plains of the Midwestern USA, in the Australian grain belt, or in the central Asian steppe. The answer is simple. This is their home - their past and their future. They are committed to making the best of what they have.

Poverty

The semi-arid tropics (SAT), as the home of the poorest among the poor of more than 300 million people, offers the biggest development challenge.

The continuing food deficits in the semi-arid tropical countries accompanied by a general degradation of natural resources has impacted several sectors of their economy. Amongst the worst hit are small farmers. In this eco-region the number of rural poor is on an increase, the feminization of poverty is being institutionalized, and jobless economic growth is increasingly being witnessed.

Due to extensive and large-scale migration to the urban areas of the able-bodied rural poor - particularly the men, the feminization of poverty is increasingly being observed. Further globalization of agriculture has increased urbanization. The implementation of the new economic order, has increased the jobless economic growth over the last decade in India, Kenya, Zimbabwe and Brazil to give just a few examples from the semi-arid tropical world. The food habits of the people have also undergone a remarkable change.

Food Security

A recent report published by the Worldwatch Institute, a Washington DC-based environmental research organization, paints a rather grim picture of constraints to sustainable development in the future for the countries experiencing rapid population growths. This institute predicts that by the year 2050, the population of Ethiopia (currently 62 millions) is estimated to more than triple to 213 m. Similarly, Pakistan will surpass the US population before 2050. Nigeria, meanwhile, has been projected to increase her population from 122 million today to 339 m, giving it more people in 2050 than there were in all of Africa in 1950. The largest absolute increase, however, is anticipated for India, the host country of ICRISAT, which is projected to add another 600 million people by 2050, thus overtaking China as the world's most populous country. All the example countries included for this demographic analysis are endowed with substantial sections of semi-arid tropical lands. The requirements of food are going to be daunting in this ecoregion.

opportunities posed as African agriculture develops from a subsistence-based enterprise to a market-driven situation.

ICRISAT is known worldwide for intensive village-level economic studies in India. Some parallels might be drawn between South Asia and sub-Saharan Africa, because in both regions the poor are highly dependent on the coarse grains and drought-adapted legume (pulse) crops.

ICRISAT's strategy is built upon the over-arching goal of improving livelihoods and human welfare. It will address any systems issue where it sees an opportunity to make a difference, even if these needs or opportunities extend beyond the traditional crop mandates. ICRISAT will actively catalyze partnerships to bring to bear the relevant, high-quality skills on the priorities it and its partners identify.

ICRISAT's Africa Agenda will focus on the dominant theme of despair in African agriculture: the downward spiral of soil fertility loss, soil erosion, and crop-yield decline. ICRISAT's partnership-based strategy for Africa views soil fertility improvement as a key leverage point that can deliver major benefits to the poor, while enhancing food security and the environment. By arresting and reversing this spiral of doom, farming systems will be reinvigorated, sustainable management practices will become economically viable, and the productivity potential of improved germplasm will be expressed. The joint challenge for ICRISAT and its partners will be to ensure that products are available at all points along this trajectory which are appropriate, affordable, within farmers' risk tolerance levels, and sufficiently remunerative to reward investment.

ICRISAT will put a human face on agricultural research, by investing in socioeconomic studies to ensure that research efforts are also sharply targeted towards poverty reduction and gender inequity, as well as being sustainable, adoptable, and appropriate. Farmer-participatory approaches, working closely with partners will be a core methodology applied across ICRISAT's agenda.

ICRISAT's Africa Agenda will include highly focused crop enhancement research so that well-adapted, improved varieties are available, as well as crop protection and resistance research so that productivity gains are stabilized, reducing risk – an overriding concern for poverty-stricken smallholders.

Efforts to increase productivity in the past have also run aground because of the limited demand for neglected crops in formal seed and market channels. The new approach will not stop at the farm gate. It will find solutions to these issues, ensuring that seed is available and that the commodities that the SAT is uniquely suited to produce can be sold reliably for remunerative prices. ICRISAT will look beyond just the edible grain value of its crops, factoring in market potentials for feed and fodder, oil, industrial stock material, and other value-added products through close collaboration with relevant institutions, including the private sector and NGOs. Commercialization of sorghum and millet in southern Africa will be new areas in which ICRISAT will concentrate on in the future.

ICRISAT's Africa Agenda is integrated within its Center Medium Term Plan 2001-2003 Projects, which are global in character. ICRISAT's research thrusts on the continent will coalesce around the soil fertility-enhancement intervention strategy.

To develop the SAT ecoregion, ICRISAT will enhance soil fertility a major factor for increased crop productivity, input efficiency, and sustainability. ICRISAT will work on the difficult desert margins in collaboration with institutions worldwide having similar concerns. ICRISAT will work towards introduction of legumes in an effort to diversify Africa's cereals-based systems while intensifying our work on cereals—sorghum and millets.

Integrated management of pests and diseases will nevertheless continue to be a major research area for ICRISAT as will be safeguarding and disseminating genetic resources held in trust with ICRISAT. New tools will be used in the future Africa strategy of ICRISAT: modeling, geographic information systems, biotechnology, and information technology. National agricultural systems in Africa will be assisted to absorb these empowering technologies within their own institutions in a sustainable way.

Impact of ICRISAT's interventions in the agro-ecosystem will only be evident if new markets for ICRISAT crops are identified for the crops, and farmers have access to seed of improved varieties through new institutional mechanisms.

Partnership themes take added significance for ICRISAT in Africa. ICRISAT believes that in order to enhance technology to strengthen its Africa programs, strengthening regional networks and partnering with regional fora are essential prerequisites. ICRISAT will strive to work on multi-country projects focused on specific priority issues and will increase its partnerships with NGOs, the private sector, women, and farmers' groups. When ICRISAT works with farmers as it is doing in soil fertility research in Kenya, Malawi, and Zimbabwe, it will not be doing work *for* farmers but *with* farmers.

ICRISAT will heavily commit its human and operational resources in order to meet the objectives of its strategic partnerships in Africa. Two of its three Program Directors are based in Africa to provide solid leadership. The steady support of the CGIAR donors to research for Africa over the past quarter-century has been remarkable, and has enabled the creation of a large and valuable resource of SAT technologies, information, and trained national scientists. The additional targeted contributions of many donors generated strong synergies with the core contributions, enhancing impact in targeted areas. Together, this support has enabled ICRISAT to establish a superb research-for-development capacity and partnership on the continent.

For the ambitious objectives and still-greater promise of the Africa Agenda to be met, this strong support must not only continue – it will need to be enhanced. Since 1993, available resources have declined steeply, constraining the ability of ICRISAT and its partners to carry out many worthy initiatives.

in future scenarios. Most analysis to date indicates that global warming will be a slow process which is unlikely to have serious consequences for decades, and which will have both positive and negative effects, i.e., it may cause some regions of the world to become less suited to agricultural production and others to become more productive.

But the greatest effects on the productivity of agriculture will come from increased weather variability and higher moisture stress of crops; these will be most evident in low and middle latitude areas. Low-income countries in those latitudes, such as the Sahelian countries, would have adverse effects from climate change on their food security, assuming dependence on agriculture remains high in the future.

Water Scarcity and the Challenge of Raising the Productivity of Water in Agriculture

When the Green Revolution started in the 1960s, water was not seen as a major constraint to increased productivity in potentially productive areas. Indeed the rapid expansion of irrigation has been one of the 'engines of growth' over the past 50 years. This situation has changed. The cost of developing water resources has risen and the competition for water from all sources has increased. Water has become relatively scarce compared with the situation that existed in the 1960s. In addition, overuse or misuse of water resources has resulted in serious environmental degradation problems in numerous areas.

The Philippines as a case

The world situation that I painted before you today is not alien to the Philippines. Poverty incidence is still high and rice importation is still taking place. The quality of our environment is deteriorating and our natural resources are degrading. We have to put our act together and help our government lift up the poor and the hungry.

ICRISAT in the SAT

Let me briefly encapsulate what it is that we do at ICRISAT. We do science with a human face. We focus on research for development to improve agriculture in the semi-arid tropics, where short and irregular rains, coupled with nutrient-poor soils, make food production an unpredictable enterprise. Despite this element of risk, most of the people in the dry tropics work in agriculture, or an industry dependent upon it. ICRISAT's goal is to help them improve their lives by making best use of the resources of the semi-arid tropics for agricultural production, without degrading the environment that is their children's birthright.

The word 'tropics' brings to mind the lush climates of tropical rainforests like what we have here in the Philippines. The less-publicized dry tropical areas, though, actually cover a huge portion of the earth's agricultural land, including the majority of the African farm landscape. People have lived in the dry tropics for millennia, including

be managed efficiently and responsibly, not only for purposes of raising agricultural productivity, but because of the essential, though not always economically valued, goods and services they provide. Until now, in many cases people have relied on tapping unexploited resources to meet their growing food demands, for example, appropriating fresh water runoff, mining the soil's fertility or converting forests to agriculture. Not only is there a limit to such exploitation, but also the trade-off among these goods and services is often excessive, such as increased food at the expense of clean water, timber, biodiversity and flood control. Many experts are now calling for a greater inter-sectoral approach to resource management (ecosystem management) where the goals of sufficient food, clean water, air quality, safety and other ecological requirements are addressed in an integrated framework.

At the same time, it should not be assumed that developing country households would automatically adopt natural resource management practices and conservation investments in the interests of a more ecologically balanced world.

Water and Irrigation

Irrigation uses more water than all other sectors combined, and China, India and the USA are by far the largest consumers of irrigation water. Irrigation, however, is growing more slowly than any other type of water use, and is expected to increase by only 17% up to 2025. Indeed, in many systems, the share of water used by agriculture will decline significantly in the face of competing demands from the urban sector. Unless properly managed, lack of access to fresh water may well emerge as the key constraint to global food production. Resolving water conflicts could become the single most important resource-management issue in the future, i.e., inter-sectoral management issues (water for agriculture, drinking, industrial uses, environmental uses including fisheries) within states and countries as well as water agreements between countries. Water quality will be a crucial issue, as will contamination of aquatic resources inhibiting fisheries and aquatic ecosystems at large. With a growing scarcity of water worldwide, but particularly in specific regions, such as the Middle East and South Asia, increasing the capture of freshwater runoff and enhancing the productivity of water in agriculture will become paramount. In some cases, the most pressing tasks relate to soil salinization and waterlogging.

Unsuitable management practices create both on-site and off-site damage to water resources. Cultivation, fertilization and the use of chemicals lead to off-site river and canal pollution, siltation and other problems, and these effects can be widespread. The challenge is to identify the right institutions and policies to encourage responsible use and management of irrigation water by upstream users.

Global Warming / Climate Change

Adverse impacts on agriculture deriving from climate change are difficult to predict. It is, however, true that climate change is a reality and needs to be taken into account

ICRISAT intends to proactively convince development investors to ensure that they become fully aware of the magnitude of the opportunities to reduce poverty and food insecurity, manage the natural resources, and enhance productivity through partnership-based research-for-development focused on SAT Africa. ICRISAT will take on board the priorities and concerns of those investors in the process, to be sure that their development aspirations are effectively addressed within the agenda. ICRISAT will also ensure that NARS and other partners continue to be fully engaged and are frequently consulted in further evolving the Agenda, and in placing joint proposals before development investors. Through these interactions, ICRISAT believes it can and it will be able to find ways and means to catalyze a new future of hope for the poorest of the poor across the SAT of sub-Saharan Africa. We can do it — together — linking our hands in partnership.

Thank you.

Science with a Human Face

Potent Tool for Poverty Reduction and Food Security

Science and Technology School
Los Baños, Laguna
Philippines
1 April 2000

Introduction

I am happy to be present at the Graduation Exercises of the Science and Technology, School of Los Baños. It is an honor indeed for me to address the graduates of this growing institution.

Since early January this year, I am heading the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), with its headquarters at Patancheru, India. ICRISAT is one of the 16 centers of the CGIAR and is a sister center of IRRI. ICRISAT is responsible for agriculture in parts of the world with low rainfall, poor soils and variable climates. It covers most of Africa, called the sub-Saharan Africa and parts of Asia, primarily south-Asia, and some parts of Latin America and Australia. It is also where more than 300 million poor people live.

World Situation

Poverty

Who are these poor people? And how do we define poverty? There are three broad classifications of poverty: Income poverty, nutritional poverty, and rural vs. urban poverty.

Income poverty

Of the estimated 1.2 billion people who currently fall below the international poverty line, i.e., who earn less than US$1 per day, 43% of the world's poor live in South Asia, 24% in Sub-Saharan Africa, 23% in East Asia and the Pacific, 6% in Latin America and the Caribbean, 2% in Eastern Europe and Central Asia, and 2% in the Middle East and North Africa. With the exception of some large countries like China and India, absolute numbers of poor are not expected to decline appreciably by the year 2010. It is reasonable to assume, based on current figures and trends, that by 2010, the highest share of the population living in absolute poverty will still be in South Asia and Sub-Saharan Africa.

Nutritional Poverty

The numbers fall out a little differently when estimates of hungry people, i.e., extremely poor, are considered. FAO estimates that there are currently 791 million undernourished

people, of which about 180 million live in Sub-Saharan Africa, and 204 million in India, Clearly, most of these would also classify as income poor. But whether considering the number of income poor or the undernourished, the numbers themselves are staggering and it is unlikely that they will decline dramatically over the next 10-15 years. Recent research indicates that more than three-quarters of the developing world's malnourished children will still be found in Sub-Saharan Africa and South Asia in 2020. Furthermore, child malnutrition is expected to decline in all developing regions except for Sub-Saharan Africa, where the number of malnourished children will increase by 30% over the next twenty years. This suggests that overall poverty is likely to increase in Sub-Saharan Africa.

Rural vs. urban poverty

Poverty in developing countries is still primarily most widespread among the rural population and is expected to remain so for the foreseeable future. Nearly three quarters of the poor live in rural areas. In general, the rural poor are worse off than the urban poor because they have fewer opportunities to make a living. Overall, the indications of malnutrition are much higher in rural areas than in the cities, and the rural poor depend more on agriculture and on common property resources than the rural non-poor.

Between 1975 and 1998, the urban population of developing countries increased by 1.2 billion. In the next 25 years it will increase by an estimated 2 billion, essentially doubling the urban population in just 25 years. The urban share of the total number of poor is expected to rise to 40% by 2020.

Food Security

In the light of recent developments and likely future developments, which countries and regions are most at risk in terms of meeting future food security requirements? Numerous developing countries have failed to make progress in raising per capita food production over the past 20 years. A large share of the population in many of these are countries with a high degree of dependency on agriculture, where per capita food supplies are already very low, are undernourished. Indeed, it could be argued that all countries falling below the 2300-calorie threshold level, which have had negative or very small growth rates of per capita food production (1972-92), have a high food-security risk for the future. It is in these countries where current trends indicate poor prospects for significant and steady growth in per capita food production and where prospects for income from non-agricultural employment are not promising.

Environment / Natural Resources

In discussing the challenges ahead in raising productivity levels to meet food and other commodity requirements for a growing population, the potential adverse, as well as positive, environmental externalities must also be considered. Natural resources must

years of generating new technologies and knowledge. However ICRISAT is restructured during the next ten years (by 2010), it has a fundamental responsibility to ensure that during the interim period as many as possible of the already generated technologies are made available for adoption by farmers. Here is where ICRISAT's role as the "bridge, broker and catalyst' for the SAT will be greatest. ICRISAT should give as much support (and funding) as possible to **both** promoting existing "adoptable" technologies and generating new technologies. If the lack of adoption of "adoptable" technologies is due mainly to institutional, political and infra-structural bottlenecks, ICRISAT will need to develop the right partnerships to address these constraints. With the substantial progress made in the past five years in increasing the efficiency of generating "strategic, international public goods" such as the outputs of biotechnology and applied genomics research, there is potential for the CGIAR to produce potentially useful improved crop varieties and other outputs far more quickly than ever before. Unless the identification and building of uptake pathways is given equal attention - supported in parallel to keep up with this process, the impact of the new technologies may not be realised. This is a highly important issue for many donors. ICRISAT needs a holistic approach to both generation of new technologies and knowledge as well as its promotion. All center-wide projects need to address both issues.

Partnerships

Whatever ICRISAT's future strategy, partnerships will continue to be the functional base for impact. Much of ICRISAT's past and current contribution to agricultural research for development has only been possible through a unique suite of partnerships with NARS and regional networks, IARCS, ARIs, NGOs, farmer groups, and more recently with the private sector. **Nothing prevents any CG center from joining forces with any other CG center and/or with any of the above partners through a variety of established mechanisms.** Similarly, nothing prevents any CG center or group of centers from developing new partnerships based on needs and interests. **Formation, promotion and management of successful partnerships does not need a systems-wide centralised system.** In **fact,** one would imagine based on the multitude of players and countries involved, that the complexity of the concept would dissuade even the wildest enthusiast.

The present well-managed partnerships enjoyed by most CG centers generally reduce transactional costs, optimise risk allocation, augment resources and core competencies, and increase the potential scale of impact. Long-term partnerships based on trust are an essential prerequisite for uptake and adoption of research outputs. It is likely that gross centralisation will greatly increase transactional costs and, in the foreseeable future, not significantly enhance the ability of centers and the CG as a whole to achieve its mission.

There is no doubt that new partnerships and new modus operandi will be needed by ICRISAT in the future, especially as it responds to the CG 2010 strategy. There is also no doubt that where needs are identified, new and stronger partnerships will be developed with other CG centers and their current partners - regionally, ecoregionally and globally. It is expected that non-traditional partnerships will grow as increasingly politi-

Provide a strong impetus to the adoption of a task force approach to the organization and delivery of its products and services.

Serve as a catalyst, organizer, coordinator and integrator of global efforts on key opportunities and constraints in agriculture, forestry and fisheries.

I feel we are much within the new CGIAR Vision and Strategy as we have proactively considered in the finalization of our new rolling MTP which has also been endorsed by TAC formally at MTM 2000. ICRISAT's mission is to help the developing countries in the semi-arid tropics through increased agricultural productivity and ensuring food security, reducing poverty and protecting the environment through partnership-based research with NARS, ARIS, NGOs and the Private Sector. The SAT is a home to 850 million people of which 300 million are poor who are unable to meet basic needs. Further, the natural resources are already severely degraded. Our research work has a direct bearing on the well-being of the poor people living in the SAT and we direct our efforts towards reducing the poverty in the region and so our strategy is to do science with a human face.

The topic of desertification or land degradation in arid, semi-arid and sub-humid tropics which is the central theme of this brain storming session is very timely and needs an urgent attention. Of all degraded soils, 58 percent are drylands and no class I soils which are good for crop production are in the tropics.

Earlier, we visited the Asian Development Bank in Manila and we were happy to learn that they are interested in pursuing work on desertification in Asia. This is a welcome development for all of us in the region. And that only when we had the JIIPAC meeting in New Delhi, we challenged the group to jointly formulate a proposal on this very important concern, the war against desertification.

The largest degraded area of agricultural land in the world (1475 million ha) is in Asia and this is also one of the densely populated regions in the world. The two most populous countries of the world, India and China, figure prominently in the UNEP's World Atlas of Desertification. The resource poor farmers who are following unsustainable practices are overexploiting the available land and water resources. In South Asia, the annual loss in productivity due to soil erosion is estimated at 36 million tons of cereal equivalent valued at US $ 5.4 billion and US$ 1.8 billion due to wind erosion. The annual economic loss due to soil fertility depletion in South Asia is estimated as US $ 600 million for nutrient loss through erosion and as US $ 1.2 billion from soil fertility depletion as per UNEP's estimate.

The problem of desertification which is manifested through land degradation is attaining a gigantic proportion and threatening the well-being of the large number of people residing in Asia and Africa. It is very appropriate that we all have gathered here to deliberate and decide the strategy to combat desertification. This problem is a complex one and covers a large geographical area, and unless we join hands to work out a strategy to combat desertification it will not be possible to increase productivity and reduce the poverty of millions of people living in the SAT.

My colleagues, Drs. B.I. Shapiro and S.P. Wani in consultation with ICAR scientists have developed a plan for this brainstorming session to prepare a strategy paper distilling the outputs from your deliberations so that we can prepare a detailed proposal (PDF grant) to undertake the research to combat desertification in the dryland areas of Asia for submission to GEF through ADB. I wish to mention that we will have further consultations with other relevant NARS in the region. I wish you all a very productive stay at ICRISAT and we look forward for a concrete action plan from these deliberations to increase productivity and minimize desertification in Asia. We must win this war against desertification. Once again, I wish to emphasize that we need to do science for improving the well-being of the humankind with a human touch. Ladies and Gentlemen, I wish you good luck and look forward to the output from your deliberations.

Thank you.

Each role/responsibility and group of activities has been developed to different extents and for different purposes (and in response to donor funding!). Most ICRISAT scientists have experience of functioning at all three levels effectively, efficiently and productively. Operationally (within current staff limits), the three levels are well integrated and interactive. The research strategy and outputs are subject to semi annual and annual evaluation and monitoring through internal peer review and targeted external reviews (e.g. CCERs).

Any system-wide restructuring of governance and operations should build on the long experience of past successes in addressing the needs of resource poor farmers in the SAT and the needs of poor consumers through cheaper food. This institutional capability and memory may be under-rated, as perhaps do the valuable partnerships that have contributed to the achievements. The present somewhat polarised debate could be accused of "throwing the baby out with the bath water". It would appear to be counter-productive to artificially separate out any one of these roles or responsibilities into a new ICRISAT strategy.

Fundamental for future structure

The research strategy of ICRISAT - like most CG centers - is needs driven. Center-wide projects undergo a rigorous and comprehensive priority setting process to identify problems, opportunities, activities and outcomes. The appropriate approach to a specific problem may be global, eco-regional, regional, a combination of all three, or even use of all three at different times during the research cycle (strategic, applied, adaptive). To compartmentalise the mandate of a CG center into only one of these could be, in many cases, detrimental to the key elements of the CGIAR Strategy and Vision for 2010 - especially to reducing poverty, hunger and malnutrition.

ICRISAT can provide numerous examples of the impact of spillovers from one region to another (justifies the eco-regional approach – e.g. Okashana I in Namibia; S35 sorghum in Chad and Sudan etc.). Globally, the past characterisation and evaluation of mandate crop germplasm provides an invaluable base of information for current and future crop improvement. On-going advances in applied genomics research and biotechnology will continue to build on this foundation.

Conclusion: ICRISAT's future strategy - and its relationships with other centers and partners - should be determined by needs and rigorous priority setting based on appropriate stakeholder consultation rather than a compartmentalised approach.

Priority future emphasis (if ICRISAT is to continue to attract donor support)

The most critical priority for ICRISAT to address during the next five years is **promotion of research technologies and knowledge for uptake and adoption to achieve measurable impact.** ICRISAT is considered by donors to be a mature institute after 25+

Towards a New ICRISAT Strategy: Global, Eco-regional and/or Regional

Briefing Document for the CBC/CDC Retreat

The Hague
2-3 September 2000

Useful citations:

" The CGIAR is.....*perhaps the most successful partnership in the history of development "*

James Wolfensohn
President, World Bank

"There can be no long-term agenda for eradicating poverty and ending hunger without the CGIAR "

Maurice Strong
Chair, 3rd System Review Panel

General background

The CGIAR 2010 Vision and Strategy should build on past and current successes rather than creating a potentially less useful and less productive structure/organization. ICRISAT has made and continues to make a substantial contribution to agricultural research and development in the SAT (and beyond) through the generation and promotion of outputs from research on genetic enhancement, natural resource management, and socioeconomics and policy. ICRISAT feels that it can continue to contribute strongly to global, eco-regional and regional environmental and agricultural needs and opportunities based on this past experience. But, ICRISAT needs to better articulate and emphasise this as it appears that some donors need to be educated.

Roles and responsibilities

The past and current strategy followed by ICRISAT embodies global, eco-regional, and regional roles, responsibilities and activities. For example:

- **global:** genetic resources collection, conservation and improvement (global mandate for sorghum, pearl millet, groundnut, pigeonpea and chickpea; current applied genomics research; associated database management)
- **eco-regional (SAT):** crop improvement, natural resource management, SAT futures and policy research in the semi-arid tropics – historical movements of ICRISAT's mandate crops between SS Africa and South Asia supports the eco-regional focus
- **regional:** South Asia, West and Central Africa, Southern and Eastern Africa.

SAT Futures Brainstorming Session (Patancheru)

Opening Address

25 July 2000

Dr. Jim Ryan, Program Directors and Friends,

I welcome you to this brainstorming session on SAT Futures. All of you are aware of the term SAT or the semi-arid tropics. These are the harsh geographic regions of Asia and Africa characterized by poor soils and low rainfall. These are also the regions in which the poorest of the poor have to struggle to survive. All of us agree—and the CGIAR agrees with us—that all efforts need to be made to alleviate poverty in the SAT first, before all other regions of the world, because of the simple fact that the largest numbers of the poor live in the SAT.

The facts that stare at us are ominous. In the SAT, the number of rural poor is on the increase, the feminization of poverty is being institutionalized, and jobless economic growth is increasingly being witnessed.

A recent report published by the Worldwatch Institute, a Washington D.C.-based environmental research organization, paints a rather grim picture of constraints to sustainable development in the future for the countries experiencing rapid population growths. This institute predicts that by the year 2050, the population of Ethiopia (currently 62 million) is estimated to more than triple to 213 m. Similarly, Pakistan will go from 148 m to 357 m, surpassing the U.S. population before 2050. Nigeria, meanwhile, has been projected to increase her population from 122 million today to 339 m, giving it more people in 2050 than there were in all of Africa in 1950. The largest absolute increase, however, is anticipated for India, the host country of ICRISAT, which is projected to add another 600 million people by 2050, thus overtaking China as the world's most populous country. All the example countries I mentioned are endowed with substantial sections of semi-arid tropical lands.

This does paint a bleak scenario for the SAT. On the other hand, if the SAT is seen as a land of opportunity waiting to be commercialized, a different scenario emerges. Biotechnology, genomics and information and communication technology, for instance, are new tools that could open new markets or expand existing markets, changing the economic forces that affect the population that inhabit the SAT. To enable this economic change, alternative strategies to resolve constraints to commercialization need to be tested.

We are gathered here to help establish an on-going process to maintain a strategic knowledge base on the SAT that will help reduce poverty and increase agricultural productivity to enhance food security. A two-phase action plan is suggested.

Phase 1 is development of base documents on the "Future of SAT Agriculture". First, a synthesis of ICRISAT and its partners' views on critical issues in SAT agriculture will be written based on an extensive participatory process of brainstorming. Today's activities constitute a part of that exercise. Second, background information on population, production and productivity of the SAT would be collated from diverse published sources. Then, currently available knowledge on sustaining productivity and the quality of the eco-environment of the SAT would be documented and efforts made to get the known technologies implemented. This will include a review of relevant World Bank/IFPRI and other relevant documents. Third, issues for future research would be catalogued.

Phase II will involve follow-up regional consultations of key stakeholders through the global and regional fora. A conference will be sponsored to discuss the problems impinging on the prosperity of the SAT and a corresponding research for development strategy. A plan for the harmonization of inter-institutional roles of international, regional and national agencies operating in the SAT region vis-à-vis NARS in carrying forward the agreed research agenda will be suggested. Finally, an ICRISAT Vision and Strategy Plan and the ICRISAT Medium Term Plan will be developed based on the above inputs and consultations and in partnership with ICRISAT stakeholders.

Why are we doing this? It is time for ICRISAT and the world at large as we enhance science with a human face, to look at what could transform the world of the SAT from a place where the poor multiply in alarming numbers and despair is omnipresent among the poor.

This is valuable information for the CGIAR's Technology Advisory Committee, which is clearly aware that poverty is a major global problem and needs to be reduced. As the largest numbers of the poor live in the SAT, ICRISAT's pro-active approach to underpin productivity and generate additional income for the population will be pivotal for resolving several emerging policy issues. If we go ahead with a clear vision, ICRISAT will have a robust future and development investors will be pleased to be associated with us.

Population, production, and productivity of the SAT are only a part of the mosaic affecting our future. Environmental concerns of the SAT are equally important and impinge our daily lives. Land degradation, climate change, water quality and quantity are some such concerns that will affect all those who live in the SAT. So will biodiversity changes with regard to natural vegetation, crops and livestock.

ICRISAT is well positioned to sensitize the NARS and other institutions in the SAT on the organization of markets, communications and sustainable production systems to create demand for the already existing agro-technological options. We need to assist and increase the public sector in this important thrust. In order to do this we need to provide opportunities to improve human resource skills. At ICRISAT we have done this before but we need to do more.

Last but not least, we need to forecast major achievable breakthroughs in science—in germplasm development, farming systems, natural resource management, value-added

water resources are just a few of the urgent issues that threaten livelihoods in the SAT over the coming decades. We need to examine whether and how ICRISAT's research can influence outcomes in these areas in a significantly positive way. This is where your inputs as leaders and experts in Asian agriculture will be so valuable to us.

You will note that we are calling this initiative "SAT Futures". The plural emphasizes that there are many possible scenarios for the future of the SAT. There is no single prescribed future.

Today all of you will throw up a variety of ideas that could all be true. But these seminal ideas will help us **explore options** and **expand our imaginations**. Let us not underestimate the **power of ideas**. Some of the ideas you raise here could become the seeds that grow into new research initiatives and new discoveries, leading to investment and policy decisions that ultimately improve the lives of thousands or even *millions* of SAT poor.

All of you know Asian agriculture and the SAT very well and therefore are exactly the types of advisors we need at this moment.

What we suggest today will impact on the 800 million people who make the SAT their homes, for **better** or for **worse**. Let us do what we can today and tomorrow to **tip that balance *decisively*** towards the **better**. This is my hope - and my expectation - of this distinguished and outstanding group gathered here today. Let us work together and chart that roadmap to the future for the Semi-Arid Tropics.

A recent report published by the Worldwatch Institute, a Washington D.C.-based environmental research organization, paints a rather grim picture. By the year 2050, the population of Pakistan will more than double to 357 m, surpassing the U.S. population. The largest absolute increase, however, is anticipated for India, which is projected to add another 600 million people by 2050, overtaking China as the world's most populous nation. All these countries are endowed with substantial areas of semi-arid tropical lands.

This does paint a bleak scenario. On the other hand, if we look at the SAT as a land of opportunity waiting to be developed in a sustainable manner, a different scenario can be envisioned. We believe that through science and technology in partnership with a wide range of stakeholders and doing it with a human face, we can help steer the course of the future for the SAT from one of a potential ***basket case,*** to a ***breadbasket:*** providing food security, economic growth and hope. We are gathered here today and tomorrow to begin to sketch out a **roadmap** in our quest for this brighter future.

These consultations are part of a three-phase action plan.

Phase 1 is assembling and analyzing critical base documents including background information on population, production, productivity, economic efficiency, and other important parameters. It includes an inventory of technologies that are ready to deliver impact, now.

Phase II involves brainstorming consultations of as wide a range of experts as we can possibly assemble, to help us identify critical researchable issues for the coming decades for SAT agriculture. Today's consultations with you, our NARS partners, constitute a part of this exercise, which will continue.

In Phase III, an ICRISAT Vision and Strategy Plan and the ICRISAT Medium Term Plan for 2002-2004 will be developed based on these consultations and analyses, involving additional consultations with yourselves and the whole range of our partners globally.

There are so many priorities crying out for attention. Global warming, population growth, poverty, natural resource degradation, policies inhibiting agriculture, and declining agricultural products—products that may be related to livestock or any product of economic importance.

You will note that we are calling this activity "SAT Futures". The plural emphasizes the possible scenarios in the future for the SAT. There is no single prescribed future. Today all of you will throw up a variety of ideas that could all be true. But these seminal ideas could lead to investment and policy decisions by NARS, which could improve the lives of increasing numbers of the SAT human population.

All of you know the SAT very well and therefore are appropriate advisors. There can be no one better to lead this exercise than Dr. Jim Ryan who is an economist of repute and a former Director General of this Institute.

Today people are talking of e-futures in information technology. Let us come up with SAT futures that will make the private and public sector sit up and be motivated to be an active partner of the important strategy to improve the lives of 800 million people living in the fringes of poverty. Please remember that what you come up with today can make a difference to millions of people. What you can suggest as possible options can also be valuable inputs to decision-makers contemplating changes within the CGIAR.

Let me report to you what transpired in our meeting in London with the new Chair of CGIAR, Mr. Ian Johnson. I would characterize in brief that said meeting is a breath of fresh air for the whole CG System. The new Chair and the World Bank do not only recognize the importance of science and technology in increasing agricultural productivity and reducing poverty in the developing countries but as well pledged that the Centers be given enough resource to do the right kind of research work. The new Chair is looking forward to a yearly budget of $ 500 m a year for the system being a success story by itself having demonstrated how its science and technology work has helped to improve people's lives in the neediest areas of the world.

Mr. Johnson also emphasized the need to enhance behavioral changes in the system and the Centers. He would like to see more inter-center work as well as work with the developing countries. He will initiate the streamlining of the secretariat and many existing committees to include the role of TAC. He sent the message that business as usual is no longer possible today and in the future and much work remains to be done for the whole system. Part of this is for ICRISAT to really create a new culture and chart its future and work on very critical and important research issues in the semi-arid tropics of Asia and Sub-Saharan Africa.

My best wishes to all participants in this important exercise.

Aflatoxin Project Workshop

Welcome Address

26 July 2000

I would like to extend a cordial welcome to all the participants, in particular to our collaborators, Drs. Craufurd and Wheeler who arrived here from the UK and Drs. Lanting of AME, Rama Devi of STAAD and Padma Raju and Subrahmanyam from ANGRAU, India. I also would like to welcome Drs. A Bandyopadhyay and Desai from NRCG in Junagadh; Mr. C.L.N. Rao from Janaki Feeds; and Mr. Venkataramani of "The Hindu" newspaper. Of course I would specially mention Natural Resource International for your generous financial support for this important project on aflatoxin under the leadership of D.V.R. Reddy. Also special mention has to be made about DFID, being one of the important development investors supporting ICRISAT.

As all of you know cultivated groundnut or peanut is a multipurpose crop providing cooking oil, vegetable protein for human and livestock nutrition, and haulms as cattle feed. Aflatoxin contamination of groundnut has been recognized as an important global constraint, because aflatoxins are potent carcinogenic, mutagenic, teratogenic and immunosuppressive agents. As a result they are harmful to human beings as well as livestock. In a recent report by four medical doctors **LIVER CANCER** in India was shown to be due to the combined influence of aflatoxin contamination and hepatitis B virus infection. Concerns over aflatoxin contamination of Indian groundnut in **both domestic and international markets** restrict the access of groundnuts produced by **marginal farmers to these important and lucrative markets.**

There is a very good reason why this project has been initiated. ICRISAT, through funding from DFID, developed cost-effective tools for the quantitative estimation of aflatoxins. A recent survey carried out in rural regions in India showed that **21% of groundnut samples** contained **non-permissible aflatoxin levels.**

ICRISAT has been working on the aflatoxin problem for more than 20 years. Successful results achieved in the past have led to formulation of this important project proposal. I am delighted to note that the **project will benefit marginal farmers** as well as those who would **like to export groundnuts**. It will address socioeconomic issues and will ultimately **generate strategies which will lead to reduction of aflatoxin contamination in groundnut.**

ICRISAT is now well positioned especially to contribute in the reduction of poverty via the development of agricultural practices which are cost-effective and eco-friendly, which will lead to overall improvement and well-being of marginal farmers. I would like again to express my appreciation to Natural Resources International for agreeing to fund this proposal. Dr. Lenné, who is now coming in as ICRISAT's Deputy Director General, and who is working in NRI, has played an important role in securing the funding. **It is a 4-year project**. It will contribute to a set of farmer validated

Road Map to the Future of the Semi-Arid Tropics

Welcome address at the SAT Futures Brainstorming Session with Stakeholders, Patancheru

10 August 2000

Dr. Raj Paroda, Dr. Jim Ryan, Stakeholders, Colleagues, and Friends of ICRISAT,

First of all let me warmly welcome you to this special brainstorming session on the future of SAT agriculture. It is heartening to see that some of you have come from as far as Vietnam to join us in this exercise. Your interest is a source of encouragement for all of us working to improve the lot of the poor of the semi-arid tropics, and we thank you for that. Please consider this as your home and your institution, because we look upon you as part of our family.

All of you are aware of the term SAT or the semi-arid tropics, which constitutes a part of our name - ICRISAT. These are the harsh geographic regions of Asia and Africa characterized by poor soils and low rainfall. This is where the poorest of the poor struggle to survive.

All of you are experts and leaders on Asian agriculture. You can give us valuable inputs on the problems of the Asian SAT, which is home to more than 200 million poor and that number is, unfortunately, growing. Where do we go from here? How do we solve the problems that plague the peoples of this zone? We need a **road map** through the maze of options available. We need your help to chart that road map.

The facts that stare at us are ominous. In the SAT, the number of rural poor is on the increase, including most tragically the women and children who are the future of this zone, yet are typically the most disadvantaged of all.

which chickpea is grown or expected to expand. Institutional incentives and farmer–friendly policy that would ensure dependable income to farmers will be necessary for rapid adoption of IPM technologies. We believe that this focused research and development project on on–farm IPM of chickpea could quickly result in greater availability of chickpea and reverse the declining trends in area and production under this crop in Nepal.

We at ICRISAT sincerely hope that the recommendations of this meeting will further strengthen international collaborative research to find and provide cost effective solutions to managing BGM and pod borer, the most important constraints on chickpea production in Nepal.

management strategies/technologies for reducing aflatoxin contamination **suitable for adoption by small-scale farmers.** The precise approach to dealing with the problem will be determined in Phase I of the project. I am especially delighted to know that the technologies will be developed adaptively with the active participation of both men and women farmers and the involvement of both formal and informal, public and private institutions currently engaged in support of the groundnut sector. **I am confident that the project will generate impact, and only then that our goal of science with a human face will be fully satisfied.**

Aflatoxin contamination is important in several agricultural commodities. In fact ICRISAT has also been investigating these commodities because of their use in food as well as feed by rural households. A very good example is the **discovery of non-permissible levels of aflatoxin in chilli pods as well as powders marketed in India.** I also encourage you to explore avenues which **have the potential to attract external funding**. These include development of **cost-effective diagnostic tools to other important mycotoxins, surveys to determine mycotoxins levels in foods and feeds and ways to minimize their levels.**

In fact immense potential exists to draw in to these grant proposals **both veterinary and medical doctors.** I eagerly look forward to know the progress, and will assure **you of my support to achieve the outputs of this important project.**

Planning and Implementation of On-Farm Chickpea IPM in Nepal

Kathmandu, Nepal
7-8 August 2000

Mr. Suresh K. Verma, Joint Secretary, Ministry of Agriculture and Cooperatives; Mr. A. Jha, Director General, Mr. S.S. Shrestha, Agriculture Extension Division and Mr. K.K. Shrestha, Plant Protection Division, Department of Agriculture (DOA); Dr Dhruv Joshi, Executive Director Nepal Agricultural Research Council (NARC), Dr. D.S. Pathik, Director Crops and Horticulture, Drs. Philip C. Stevenson, and David Grazywacz Pest Management Department, Natural Resources Institute, Chatham, U K, and Drs. S.P. Wani and Suresh Pande International Crops Research Institute for the Semi Arid Tropics (ICRISAT), Natural Resource Management Program ICRISAT, distinguished farmers and representatives of farmer groups, NGOs [Mrs. Bhawani Rana, SAATHI, and Mr. Santosh Kumar Bohara, Public Awareness Center (PAC)] from chickpea growing districts of Nepal and distinguished participants, ladies and gentlemen on behalf of ICRISAT and on my own behalf, I welcome all of you to this 2-day workshop on planning and implementation of on-farm chickpea IPM in Nepal. It is my privilege to participate at this meeting being held in collaboration with NARC one of the leading agricultural institutions in Nepal. The choice of Kathmandu for this meeting is most appropriate especially considering the interest of stakeholders in interacting with many Nepalese scientists who have recently made notable contribution to collaborative on-farm research on the management of chickpea diseases and insects.

I am pleased to take this opportunity to spell out certain aspects of cooperation between ICRISAT and NARC. The first ICRISAT mission in Nepal, headed by the then Director General Dr. L. D. Swindale was in 1987 and was followed by signing of the Memorandum of Understanding (MOU) for cooperation between the Ministry of Agriculture, His Majesty's Government of Nepal and ICRISAT in Kathmandu on 24 December 1987. Since then the Director General, and ICRISAT scientists have made countless visits to Nepal. Some of the notable visits to strengthen legumes research especially chickpea research and integrated pest management research have been made by ICRISAT breeders, agronomists, entomologists, and plant pathologists. We have developed and implemented collaborative workplans with Nepal, the most recent on on-farm IPM of chickpea was implemented during 1998-99 and 1999-2000, soon after the Botrytis Gray Mold (BGM) disease epidemic in the chickpea in 1997-98. This farmers participatory IPM was a part of the Crop Diversification Project (commonly known as S4-Project), which was funded by the Asian Development Bank (ADB). More than 56 Nepalese scientists and technicians have participated in various training programs at ICRISAT. Germplasm exchange has been a major activity. ICRISAT has supplied Nepal with a total germplasm of 1025 accessions and breeding lines and advanced generation lines of chickpea.

Collaboration with NARC, its regional agricultural research stations (RARS), and through its network with farmers on chickpea diseases and insect-pests has been encouraging, especially on BGM and pod borers which was most rewarding having generated basic and applied information on this pest complex. Identification of boron deficiency its association with flower drop, BGM and pod borer and their management in a holistic manner is a good example of partnership approach in tackling the complex problems.

ICRISAT's medium term plan (2001-2003) "Science with a Human Face" emphasizes the core responsibility of all scientists to ensure that results of their research reach end users through appropriate partnership and training and collaboration. Partners are treated on an equal level and engaged throughout the project cycle, from brainstorming, Planning and fund raising through execution and impact assessment. Besides assuring joint priority setting and commitment to outcomes, this approach builds real–world research skills that help national partners' ability to develop and sustain their own programs over the long run. Natural resource management research will become more participatory in its approach in the coming years, in order to fulfill its objective of increasing the adoption of management technologies. Participatory IPM (P3) research is applying innovative on-farm trial approaches that allow farmers to choose the technologies they are most interested in among the menu.

Botrytis gray mold (BGM) caused of by Botrytis cinerea Pers. ex. Fr. and pod borer [*Helicoverpa armigera* (Hübner)] are the two economically important pests of chickpea (*Cicer arietinum* L.) in Nepal. These two pests cause > 70% losses in grain yield and BGM alone can completely destroy the crop in the chickpea growing areas of the country. Also boron deficiency is responsible for flower drop, and poor nodulation can limit the realization of potential yields of chickpea cultivars. To minimize losses caused by these biotic and abiotic constraints, an integrated pest management (IPM) technology was developed and evaluated in seven villages in five districts in Nepal during 1998-99 and 1999-2000 post rainy season. This farmers' participatory research has provided an excellent understanding of the effects of cultural practices and on minimum use of pesticides for the management of BGM and pod bores. Following successful on-farm demonstration of a simple and affordable IPM package for BGM and pod borer of chickpea, 700 farmers re-introduced this crop (which had been nearly abandoned due to these diseases in the rice fallow lands in five districts of Nepal). It is therefore, to further scale up this technology transfer mission to the end users – farmers – that we have today assembled here to launch a new DFID-supported project "On-Farm Chickpea IPM in Nepal" which involved extensive stakeholder brainstorming and project pre-planning workshop at both NARC and ICRISAT. I can cite it as being a model for participatory priority-setting and project planning.

I trust in this project, with the widespread adoption of improved chickpea production technology with greater emphasis on on-farm IPM, higher yields could more readily be harvested. This would further motivate the farmers to expand the area under this crop because chickpea production would perceived as less risk-prone and profitable. Additional benefit will accrue from greater sustainability of the production systems into

Carrying this spirit forward, at Centers Week four years ago Dr. Serageldin helped us celebrate the birth of the Global Forum for Agricultural Research. He once again vividly illustrated the vision of a global agricultural research system when he said:

... we must ensure that this globalization... does not translate into a few powers dominating a world where the vast majority are relegated to being consumers of the "cast offs" of a few. In short, this system must be participatory, open, and inclusive, and built from the ground up."[2]

Dr. Serageldin's foresight in partnerships was also reflected in his success in bringing voice to two more stakeholder groups of growing importance to the System: the private sector, and the non-governmental organizations. He saw that these groups represented increasingly important constituencies in a changing world, and sought with all his efforts to build bridges where others thought there could only be walls.

Ismail Serageldin has sounded the warning about the threat of 'scientific apartheid'[3] – a concentration of research resources in the developed world combined with the trend to restrict access of the poor to the knowledge gained - even though some of it is built on indigenous knowledge accumulated by generations of poor in the developing world. Dr. Serageldin, we thank you for your voice of conscience, which has steadily reminded us that our science must have a human face.

Thanks to you, Ismail, partnerships are now intrinsic to all that the CGIAR does. Your vision has cascaded throughout the System, as we have seen partnership activity flourish over the past decade. I would like to just briefly touch on a few examples that illustrate the range and depth, and creativity that our marvelous Centers have applied in forging ever stronger and more effective partnerships during your time.

Convening global thrusts

The strategic advantage of the CGIAR as a global bridge-builder is clearly illustrated by the Global Initiative on Late Blight (GILB), modeled on the lines of Global Research Programs first outlined by Ismail Serageldin at the 1994 Mid-Term Meeting of the CGIAR. GILB brings together more than 500 members from developed and developing countries. In this way, all the tools of modern science and field experimentation and learning are brought to bear on one overwhelming constraint to production - a true global program.

Bottom-up partnerships

The importance of trust and equality in partnerships is crucial, as Dr. Serageldin emphasized. The alliance among ILRI, KARI, and the Kenya Ministry of Agriculture,

2. **CGIAR.** 1997. The CGIAR at Twenty-Five: Into the Future. Policy Statements by Ismail Serageldin. Washington, D. C.: Consultative Group on International Agricultural Research. 45 p.

3. **Serageldin, Ismail.** 1999. New partnerships and new paradigms for the new century. Current Science 76:501-506.

cal, infra-structural and institutional bottlenecks to impact are being identified. Key question: how far can CG centers push for policy, institutional and infra-structural changes? Perhaps this will best be achieved through a catalytic and facilitating role rather than directly providing that the key contacts especially in government are cultivated.

New partnerships will be essential to ensure that political and institutional frameworks are in place for capitalising on the contributions of improved technologies e.g. low or no pesticide IPM strategies, more efficient, low cost natural resource management strategies and their integration with crop improvement based on applied genomics and other advanced technologies. Single issue approaches to agricultural research will become obsolete as center strategies shift to mainstreaming poverty alleviation.

New partnerships for integrated multi-sectoral approaches will also be important. For example, although the main bottle neck to alleviating poverty in a specific locale may be the lack of a road that prevents farmers from transporting perishable produce to market quickly, once the road has been built, resource poor farmers will benefit more if the produce to be taken to market has benefited from the latest advances in agricultural research. Similar scenarios can be cited for the integration of the agriculture and health sectors and the agriculture and education sectors.

There are very good reasons for seeking enhanced partnerships in South Asia (esp. India) for poverty alleviation. Firstly, South Asia has more poor people than any other region - more than, 500 million (most are in India) - and any positive impact on poverty through an agricultural technology is likely to benefit more poor people. Secondly**,** in India especially, there is strong government commitment to economic, social, cultural, civil and political rights in addition to recognition of UN treaties and conventions. Thirdly, in India there is strong government commitment to anti-poverty politics as well as progress in economic reform supported by a strong democratic tradition and free press.

Poverty alleviation - what is possible?

Various CGIAR consultations during the past year have conducted detailed discussions on the role of the CGIAR in poverty alleviation. One of the pillars of the CGIAR 2010 Vision is to **"sharply focus activities on the reduction of poverty, hunger and malnutrition in developing countries, with priority emphasis on South Asia and Sub-Saharan Africa, the "hotspots" of poverty.** Of particular interest was the CGIAR Workshop held in Costa Rica in September, 1999. A recent issue of Food Policy (Vol 25, 379-530) is devoted to selected papers from this workshop. The main aims of the workshop were to: sharpen the understanding of poverty; clarify research-poverty linkages; and recommend institutional changes for increased impact on poverty. In this respect, the findings of the workshop are critical to the development of the CGIAR 2010 Vision and Strategy. A summary of some of the key findings is given.

Attempts to analyse linkages between poverty and favourable vs marginal environments have not shown any clear cut associations. Poverty shows extreme heterogeneity. Poverty mapping is considered useful but mapping income-poverty linkages is not enough. Other poverty associated variables should also be considered.

Poverty can be reduced through economic growth and productivity enhancement. However, the link between poverty reduction and natural resource protection is very difficult to establish.

Although agricultural research and technology generation is no panacea for the poor, it compares favourably with other alternatives. The greatest impact of agricultural research has been on the poor consumer through cheaper food.

Pathways out of poverty are numerous - the CGIAR can offer ONLY some of the solutions. It should concentrate on what it can do best - produce more and cheaper food - rather than try to tackle other solutions for which it has less comparative advantage and may be poorly equipped to tackle.

A study in India showed that poverty had declined substantially in % from 1973 to 1993 - in irrigated areas from 43 - 36% and in rainfed areas from 55 - 39%. Production returns to additional investments were higher in rainfed areas compared to irrigated areas and about 65% of the poor live in rainfed areas. **This strongly supports ICRISAT's future and should be used as a trump card.** It must be borne in mind that rainfed areas are highly heterogeneous and the returns to investments in agricultural research and development vs roads, education, electricity etc. vary greatly from locale to locale. This strongly questions the value of regional approaches to poverty alleviation as being the best for the CGIAR.

The CGIAR should give emphasis to enhancing the efficiency and effectiveness of research systems in **promoting** broad-based technical change that will impact on poverty alleviation rather than putting a major effort into targeting poverty directly.

Reality of the geographical distribution of poverty:

South Asia - 550 million poor

Sub-Saharan Africa - 220 million poor

These proportions MUST be used by centers to argue the need for far more investment in South Asia where there is not only a proven track record for the contribution of agricultural research to poverty alleviation, but also greater potential to help the poor.

Projects that generate widespread benefits to many people, particularly to consumers of mandated food crops, remain likely to be the most effective vehicles to contribute to poverty alleviation from public sector investments in the improvement of food crops in developing countries. Apart from this: **there are unreasonable expectations about the impact of agricultural research on absolute poverty.**

Mobilizing Partnerships

A Tribute to Ismail Serageldin

International Centers Week Special Session
Washington
25 October 2000

Mr. Chairman, Ladies and Gentlemen,

Ever since I first met Ismail, he impressed me as a man of leadership and great intelligence. His ability to inspire and mobilize people from diverse backgrounds made me think to myself, that some day this man will probably be the President of Egypt!

A focus on partnership was a hallmark of Ismail Serageldin's leadership of the CGIAR since the beginning. Most impressive is his global view, and his confident grasp of the complexity of issues surrounding partnerships. Thinking globally, he reminded us that both North-South and South-South partnerships and cohesion were essential for the continued relevance of the CGIAR.

Dr. Serageldin then struck to the heart of the worlds' partnership challenge when he wrote[1]:

"Our vision of global interdependence is now extending to the very fabric of our ecosystem, encompassing all forms of life. Yet, we do not appear willing to extend this intellectual appreciation to a concept of shared citizenship to all the peoples of the earth."

He reminded us that the ultimate beneficiaries must have a sense of ownership if development is to be truly sustainable:

"Development is like a tree: it can be assisted in its growth only by feeding its roots, not by pulling on its branches."

Ismail Serageldin backed up his words with deeds. His first major initiative as CGIAR Chairman was to launch the momentous Lucerne Ministerial-Level Meeting in 1995. This event brought together thirty-nine nations to re-affirm our commitment to a common vision and mission, while accepting frank comments about changes needed in the System. The 'Spirit of Lucerne' is the spirit of vigorous, open partnerships that has characterized the CGIAR ever since.

1. **Serageldin.** 1993. Development Partners: Aid and Cooperation in the 1990s. Stockholm: Swedish International Development Authority. 153 p.

for sorghum. Remember, the science we do should impact on the lines of the poor in the SAT, and the discovery – delivery and impact continuum must be enhanced to win the war against poverty, hunger and malnutrition. As partners, we must win this war together. Ladies and Gentlemen, once again I welcome you all to ICRISAT, wish you good luck, and look forward to the outcomes of these two days of a well planned program.

Thank you!!

Other issues

1. A very complex and time-consuming agenda of activities has been planned to redraft the vision, strategy and structure of the CGIAR. The cost in senior management time will be substantial. How many donors are sufficiently aware of this?
2. The outcome of the deliberations over the next 8-l0 months will influence the CG research agenda, the configuration of centers, the quality of partnerships, and further donor support. The positive and negative influences have yet to be identified.
3. Donors are not monolithic - they are highly heterogeneous. Some may welcome the changes; others may turn their backs on the CGIAR. The heterogeneous nature of donors should be factored into the deliberations. Final decisions should not be made without substantial consultation with donors.
4. Is there an obsession with science and technology? Should there be a better balance between generating technologies and promoting them to end users/resource poor farmers?
5. Donors are tired of attending fora for rhetoric and political correctness. They want operational efficiency – is this really what CG 2010 is all about?

ICRISAT's Training and Education Strategy and Experiences

The Dr. Radhakrishnan Memorial Lecture

at the
Benaras Hindu University
10 September 2000

Dear Friends,

It is indeed an honor and a privilege for me to be able to present the Dr. Radakrishnan Memorial Lecture here at Benaras Hindu University. Thank you for inviting me.

ICRISAT and the University have longstanding ties. Several of our scientific staff are BHU Alumni, and we have had the privilege of working with you and exchanging scientific visits in a number of research areas such as chickpea and pigeonpea breeding. We look forward to continuing close partnerships with you.

Considering the scholarly focus of this University, I thought I might share with you today some of our current thinking on renewing our strategy for training and education. As a mission-driven institution with very practical aims, you may find our approach to have some interesting parallels to yours, and yet it may also diverge from yours in some significant aspects. I look forward to hearing your comments and suggestions.

For those of you not fully familiar with ICRISAT, let me first say a few things about what we do. ICRISAT is a nonprofit, apolitical, international organization that helps developing countries apply science to increase crop productivity and food security, reduce poverty, and protect the environment. Established in 1972, it is one of 16 Future Harvest Centers supported by more than 50 donor governments, foundations, and development banks through the Consultative Group for International Agricultural Research (CGIAR).

ICRISAT works to improve the farming systems of the semi-arid tropical (SAT) areas of the developing world where almost a billion people live and more than 300 million are unable to meet basic needs. We work hand in hand with our partners in the national agricultural research institutes, and with their umbrella regional associations called 'regional fora'. We also work with the private and non-governmental organizations.

countries through research for development. Research is carried out by adopting an ecoregional and a regional approach diversifying and closely integrating its research partners to ensure the application of modern scientific tools to bear on the problems of the poor. We at ICRISAT, considered these aspects in finalizing our rolling MTP 2001-2003. ICRISAT's research mantra is science with human face, meaning we carry out research not for the sake of science alone, but for improving the well-being of humankind in the semi-arid tropics. Our mission is to achieve higher farm productivity and sustainability by genetically improving the cultivars in sorghum and other ICRISAT crops, and developing appropriate natural resource-based technologies for the semi-arid tropics.

Sorghum is grown in about 45 million ha globally, much of it in Africa today. In Asia, the sorghum growing area has reduced over the years, from 20 million ha in 1985 to 14 million ha in 1999, much of the reduction is due to the reduced area in India which means there is less demand for sorghum today. This could be due to several reasons. Changing people's food habits due to the availability of fine cereals at cheaper rate supported by Government subsidies could be one of the reasons. On the other hand, more and more sorghum grain is being used as feed for poultries, piggeries, and cattle. New cropping systems, such as irrigated summer sorghum and others are emerging. The demand for forage and fodder is increasing, as milk and milk products became popular in Asia in the recent years.

Secondly, donor funding has become more and more impact driven, focused and at times very restrictive. Nonetheless new tools in biotechnology, participatory breeding, and information storing, retrieval among others have been added to the conventional methods. Therefore, there is a tremendous challenge in front of you as how to blend effectively the new tools with the conventional methods to bring in the desired impact at the farm level quickly, and your success in this, of course, would help us to attract funds more and more for sorghum research.

You all have helped the ICRISAT sorghum program in the past to make its research objectives, strategy, and methodologies more focused and relevant to the needs of South Asia, much more India. I am sure that this field day provides you an opportunity to exchange information on the new tools, examine the potential, and relevance of the various products and technologies in sorghum at ICRISAT, and to bring out the needed focus in sorghum research to achieve the set impact readily at the farm level. This also helps you to select the breeding products for use in your programs.

My colleagues in sorghum have put up an excellent program involving new tools in biotechnology and aids in information technology. The program also covers the areas that are being addressed by conventional screening and breeding methods and the products derived through such methods. I am sure that you will find them relevant to your research work.

I wish all of you a comfortable and productive stay at ICRISAT and look forward to your input and partnership in shaping, sharpening, and carrying out the research agenda

Welcome Speech to Participants of the Sorghum Field Day

ICRISAT-Patancheru
14 September 2000

Ladies and Gentlemen!

Good Morning to you all. I am very pleased to welcome you to ICRISAT to participate in the Sorghum Scientists Field Day. This year's field day is unique in two ways: 1) it is being conducted after 4 years, and 2) unlike the previous field days, this time, it is being conducted with direct funding support from private sector seed companies to ICRISAT's sorghum research, particularly in seed parents and restorers development. I take this opportunity to express my appreciation for this support. I hope that this support will continue in the years ahead, not only from those seed companies already in this consortium of providing grants to ICRISAT research, but also from others.

We, at ICRISAT, are also fortunate to be working in partnership with the scientists from ICAR and universities in several areas of sorghum research under the broad umbrella of two ICAR-ICRISAT partnership projects - These are: 1) Mechanisms and molecular markers for resistance to various biotic stresses, and 2) Development of seed parents and restorers with appropriate resistances to rainy and postrainy seasons in India. Many of you are not new to ICRISAT and I am sure that you consider ICRISAT as your research base considering our partnership mode of working.

At this point, let me mention briefly the recent changes in the CGIAR, ICRISAT, and in sorghum research in particular. The CGIAR vision is: a food secure world for all. Its mission is to achieve sustainable food security and reduce poverty in developing

At ICRISAT we have three major research programs, namely, Genetic Resource Enhancement Program, Natural Resource Management Program, and Socioeconomics and Policy Program. ICRISAT has an annual budget of US$ 25 million and we work in 8 locations in the world, but networking with almost 40 SAT countries. We have strong partnership with NARS, NGOs, private sector and farmers organizations.

Throughout these partnerships, we find that mutual learning is a critical aspect. As partners learn from each other, their effectiveness increases and we all achieve more. We contribute our global scientific expertise to help strengthen the work of our local partners, who are better placed to ensure farmer uptake of new technology. Shoulder-to-shoulder and hand-in-hand, we work to reduce poverty and suffering in the dry tropical areas of Asia and Africa. We call this mission 'Science with a Human Face.'

Training – and now, Learning

This is a significant shift from the way we used to do business. When we began our mission in 1974, our partners were much less developed, and there was an urgent need for mass training in basic crop research techniques such as field plot management, making crosses and selection, etc. ICRISAT had ample financial resources and was able to fund travel to meetings, fellowships, and other student support from core. The training of about 3,500 scientists, technicians and postgraduate students from 91 countries by ICRISAT since 1974 is a major accomplishment that we are very proud of.

However, we know that we cannot just rest on our laurels. Our partners have made progress, and are now asking us for help in developing higher-level skills, such as those needed for project planning, fundraising, research management, information sharing, and impact assessment. These skills cannot be easily transferred through cookbook training courses. They are learned by doing, through joint projects addressing our shared agenda.

So the major shift in our approach to strengthening our partners has been away from rote training, and towards education – helping our partners learn how to think through and manage novel situations, to take the initiative, and to lead and catalyze action to resolve national problems.

In this way we intend to help our partners to gain more than just the technical capabilities to carry out research. We are now helping ensure that they also know how to plan research; gain support and funding for it; and demonstrate its worth to the national and donor public.

We talk much in our business about the sustainability of agriculture, and how important research is to make sure that our soils and water will remain intact and productive for generations to come. But in order to do this, we have to ensure that research itself is sustainable – that researchers become good managers and advocates for research, because without that, public support will fade away no matter how good the actual research is.

Reflecting on this new approach, we now speak of learning rather than training at ICRISAT. Our approach is to provide opportunities and challenges to help our partners develop, rather than putting them through a set of rigid training courses. We call this learning-by-doing. We act more as their mentors, and less as their teachers.

We also learn in the process, because our partners are no less savvy or experienced than ourselves. Their local experience is the perfect complement to our global knowledge. We are equals. We are building tomorrow together.

Modalities

Specifically, how does our new Learning Systems thrust operate? We offer three types of learning opportunity:

– Scholarly studies

– Joint project attachments; and

– Specialized skill courses.

Scholarly studies refer to students seeking advanced degrees, such as MSc. and Ph.D. We call these people Research Scholars. They typically enroll in a university within India or even abroad, and carry out their research assignments in the field or lab with us. Following our learn-by-doing approach, the research problem is a real one, chosen because it is a priority problem within our active research agenda. Our scientists also sit on the university committee to help evaluate the degree candidate.

Joint project attachments cater to our partners who need a particular type of research exposure, perhaps in a new area or involving a new skill. They are not seeking a degree but rather to enhance their working skills. Again, we plan the attachment to follow the learn-by-doing mode, where one of our own experts acts as both a colleague and a mentor. We call these partners Research Fellows if they are already professional scientists, or Apprentices in the case of summer students or other part-timers.

Specialized skill courses are our third type of learning opportunity. These are organized on a custom basis, to share new leading-edge research tools and methodologies with selected national scientists. For example, in recent years we have mounted courses in areas such as genetic transformation of sorghum, geographic information systems, formulating environment-friendly biological pesticides, and low-altitude aerial photography, to name just a few.

Right now at ICRISAT we are holding a course for 13 librarians selected from within the national agricultural research system of India, ICAR, to help them learn some of the many new information technologies that are transforming libraries worldwide – and to explore how this revolution will also transform their own roles from ‘document managers’ to ‘information resource specialists’.

The high number of varieties, especially hybrids, of a diverse genetic base that have been released in recent years, have contributed not only to increased productivity but also to stability of production. This cultivar diversity must be one reason why downy mildew epidemics of the 1970s and 1980s have not been repeated in the recent past. I believe that recent advances made in understanding the downy mildew pathogen and molecular mapping of host plant resistance will enhance our ability for more effective genetic management of this menacing disease. Pearl millet research at ICRISAT, conducted in partnership with several institutions in India and the UK, has made commendable progress in identifying molecular markers for downy mildew resistance. These are now being transferred into elite genetic backgrounds to salvage some of the commercial hybrid parents that have become susceptible. The future thrust will be on the strategic deployment of these genes for enhancing the resistance stability of parental lines. This is a new research area in which we need to make our partnership stronger, as it has great implications to hybrid technology not only in India but in most of the Africa as well. You will hear a special presentation on the progress made in this research area.

Another challenging and rewarding research area relates to drought tolerance. Pearl millet has, undoubtedly, evolved as the most drought tolerant cereal crop. Yet the tolerance levels in high-yielding improved cultivars may not be high enough to enable them to yield well under drought stress conditions. Thus, if improved cultivars are to be adopted in the most drought-prone environments (for instance—those in western Rajasthan), they must have necessary levels of drought tolerance. ICRISAT has a great deal of research experience in this area. You will hear a presentation that deals with this matter.

You may think of additional research areas which require strengthening of our partnerships. These could be topcross hybrids, pearl millet as a fodder and feed grain crop—and traits and selection criteria that should be used to effectively address them.

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

I wish you all a comfortable and productive stay at ICRISAT and look forward to your input and partnership in shaping, sharpening and carrying out the pearl millet research agenda. Remember, the science we do should have meaning and impact for the poor in the SAT, and science and development should go hand in hand to win the war against hunger and poverty— as partners we must win this war together. Ladies and Gentlemen, once again I welcome you all, wish you good luck, and look forward to the outcomes of this pearl millet field day.

Thank you!!

some of which also make a part of an ICAR-ICRISAT Partnership Project on hybrid parents. In other words, this partnership makes not only ICRISAT research stronger, but it also strengthens (indirectly) the ICAR-ICRISAT Partnership Project. I am sure that this research strengthening is economically as significant to those private seed companies who provide funding support, as it is to those who do not. The benefit of this research further percolated to all those involved in production and trade of pearl millet.

At this point, let me mention briefly the recent changes in the CGIAR and ICRISAT. The CGIAR vision is: 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 adopting an ecoregional and a regional approach, diversifying and closely integrating its research partners, to ensure the application of modern scientific tools to bear on the problems of the poor. We at ICRISAT, considered these aspects in finalizing our rolling MTP 2001-2003. 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. Our mission is to achieve higher farm productivity and sustainability by genetically improving the cultivars in pearl millet and other ICRISAT crops, and developing appropriate natural resource-based technologies for the semi-arid tropics.

In the context of this vision and mission, pearl millet plays a critical role in food security and poverty alleviation as this crop is adapted to and is grown in some of the most marginal environments of the semi-arid tropics. It is truly gratifying to note the impact of genetic enhancement on grain production of pearl millet in India. Despite a decrease in cultivated pearl millet area, from 12 million ha in the late 1960s to 10 million ha in the late 1990s, production increased from 4.7 million tons to nearly 7 million tons. This was due to productivity gains resulting from adoption of high-yielding varieties, although improved cultural practices also must have played their own roles.

Not all of our specialized courses are high-tech, though. Often we hold them in our partner countries so that the subjects we are studying are relevant to their needs and conditions. During the past 3 years, 15 in-country training courses were organized, in Yemen, Malawi, Zambia, Syria, Kenya, Tanzania, Mozambique, Sudan, Egypt, Pakistan, Myanmar, Vietnam, Thailand, and several other countries. Holding courses in-country allows more partners to attend, and we can tap local resource persons as well, which in itself helps strengthen national capacities for the longer term.

New tools

In addition to our new approach of learning rather than training, we are very excited about the new learning tools that are emerging from the global revolution in information and communications technology. Our partners are scattered all around the world, and this is one of the biggest problems we face in trying to share information and skills with them. Now it is becoming possible to send multimedia training courses anywhere on CD-ROM, or even share them over the internet for those partners who have good access – which unfortunately, most still do not. We know that nothing can replace a live interaction with a mentor, but these new materials are surprisingly effective and getting better all the time.

Future View

We are very excited about all these changes, and it looks like change will be the only constant in the foreseeable future as well. What are a few of the specific trends we see on our horizon?

Regionalize our approach to training

We think we will need to further customize our approach – for example, a greater focus on training in Africa, compared to the learning approach in Asia that I've been describing. By the way, there is a good opportunity here for us to act as a bridge between the two continents. Many French-speaking scientists in West Africa, for example would like to study in an Anglophone environment, so they can gain English speaking and writing skills in addition to their technical training. And being far less expensive than Europe or the USA, the Africans see India as a way they can provide learning opportunities for more people for a given amount of money.

Modernize and utilize precious learning resources

Our Library facility at Patancheru is the richest access point within our Future Harvest system for information related to the dry tropics. It is a valuable portal for Indian agricultural publications, and has links to many Indian libraries' resources as well. We see a great opportunity to use the Internet to open up these precious information resources to all the world. We call this our 'electronic library' initiative.

In fact, we see the worlds of information and learning as rapidly merging into one, through the impetus of information and communications technology. We are working towards the building of an online learning center where these two domains come together. And when we add improved communication systems ranging from email to videoconferencing, these new tools will bring our global partnerships and joint project teams much closer together across vast distances, giving them skills, information, and access to each other's expert judgments through real-time communication – all of which will dramatically improve their effectiveness.

Integrate operations with our sister Future Harvest Centers

There is a strong initiative within our Future Harvest system to explore ways we can all work more closely together to provide a broader range of products and services to our clients. We know that our independent nature, created by our original constitution, sometimes confuses our partners and is not always the most efficient way to deliver the goods. I have participated in two global meetings of my fellow Directors in the past six months for this purpose, and several of our Program Leaders will be holding discussions next week with our colleagues in West Africa to see how we can come closer together. This initiative will continue to gain momentum over the coming year.

Conclusions

With this brief overview, I hope I have been able to stimulate your thinking and now look forward to hear your ideas. Let me repeat that our learning approach is not a one-way street; we see it as much an opportunity to learn from you, as you from us.

Thank you very much for listening.

Welcome Speech to Participants of Pearl Millet Field Day

ICRISAT-Patancheru
12 September 2000

Ladies and Gentlemen!

Good morning to you all. I am very pleased to welcome you to participate in the Pearl Millet Scientists Field Day. My special welcome to many of those from outside ICRISAT who had to travel long distances to be here.

I understand it is five years since we held a Pearl Millet Field Day at Patancheru, where we plant most of our breeding materials, and conduct strategic field and laboratory experiments. I am sure that during these years, most of you involved in pearl millet research continued your interaction, in terms of exchange of ideas, research results and breeding materials. However, that would be much smaller a thing as compared to what is possible during the field day of the scale organized for today and tomorrow when it comes to selection and exchange of breeding materials—which is the main purpose of this field day.

Funding has been just one of the constraints (but a major one for that matter) that resulted in such a long gap before holding this field day. We sincerely thank those private seed companies whose grants for this year enabled us to organize this event, which benefits us all. We are also happy to note the continued commitment of those private companies who have already entered this partnership. We will work towards making this established partnership stronger in the future and encourage other private companies to become a part this research-for-development partnership. This ICRISAT-Private Sector Partnership supports a large umbrella of pearl millet research activities at ICRISAT,

ICRISAT: The Road Ahead

Address to 2000 Workplanning Week Participants
12 November 2000

Let me first extend a warm and hearty welcome to you all to ICRISAT's Annual Workplanning Week. In a time of change for the entire CGIAR, this is a vitally important meeting for us all.

As you know, in January I addressed our 2000 workplanning meeting, just as I took over as the DG. I was very new at the time, and raised a number of issues and opportunities but without a lot of specifics – I needed time to observe and learn. I have spent much of the time since then meeting you, seeing your work in the field, visiting our partners and talking to our stakeholders.

I have indeed learned a lot, so I come to this meeting with a much more concrete idea of our strengths as well as our weaknesses, our opportunities as well as our threats.

This week is itself a great opportunity to renew our agenda, to become more relevant and priority-driven. Our SAT Futures consultations have suggested some specific directions for ICRISAT, and I expect your deliberations this week to build on those too. The new ideas you raised will help us shape our objectives as we craft them into a Strategic Plan for the next decade. We have promised the Board a draft of that Plan by February, so there is no time to lose.

Now let me revisit a few of the issues I raised at our last Workplanning meeting, and the concrete outcomes that have arisen from them. I will give my impression of our progress, and outline where I think we need to go from here.

The first area I would like to discuss is partnerships. I am extremely pleased with our progress this year. Both inter-Center and external partnerships have flourished. I will just mention a few key items to make sure we are all aware of them. Please realize though, this is not to downplay any that I don't mention!

Through the 'Meeting of the Minds' process launched last year, ICRISAT and the other CG centers with a strong presence in Africa agreed to cooperate more closely - not only to improve our collective effectiveness, but also to streamline and enhance our partnerships with NARS and others in the region. Following up on this, at Dresden in May this year, the DGs of ICRISAT, IITA and WARDA signed an 'Aide Memoire' to enhance inter-center collaboration in West and Central Africa.

Shortly after that, during our RMC meeting in Nairobi, we followed suit with ICRAF and ILRI for Eastern and Southern Africa. As you know, they host our operations in East Africa and there are clearly opportunities to become more effective and efficient in a range of areas.

Livestock Development and Marketing to enhance smallholder dairying is but one of many outstanding examples in the CGIAR of successful partnerships built from the grassroots up, on a foundation of friendship and trust. This partnership became a model for strengthening research-extension-farmer links across the whole spectrum of KARI's agricultural development portfolio.

Systemwide partnerships

We all know that collective action and property rights issues are crucial in natural resource management. But they are important in partnerships too! In convening the Systemwide Program, IFPRI carried out a survey that found more than 75 projects related to this subject in progress across all the Centers. The potential synergies from being able to tap into all this were clearly enormous, but so were the challenges of bringing these diverse actors to work together.

A competitive grants system was agreed. The key to its success was the use of outside experts to make grant decisions, and a process that was transparent to all. This approach, developed with input from Ford Foundation, could serve as a model for other Systemwide Programs.

The private sector

Partnerships with the private sector are of great interest these days. Earlier fears that we might have to compromise our free public goods nature in order to engage with them, are being replaced by constructive dialogue and experimentation. CIAT, CIMMYT and ICRISAT now receive some funding from the plant breeding industry, without such constraints. These partners increasingly realize that 'a rising tide lifts all boats' – that even if they do not hold property rights over some breeding materials, they can still benefit by being proactive in multiplying and distributing those materials to benefit farming communities.

Partnerships for sustainable agro-ecosystem management

During Ismail Serageldin's term, the issues of sustainability and environmental conservation took on an increased urgency worldwide. In responding, the Centers have found that strong and innovative partnerships are crucial in managing shared agro-ecosystem resources.

CONDESAN has been cited as an outstanding example. The Consortium for the Sustainable Development of the Andean Ecoregion, convened by CIP, is a consortium of more than 75 associated groups, including universities, NGOs, communities, and local government agencies. It is an active partnership, not a passive partnership directed by an international center. Activities are inter-disciplinary, multi-institutional, and based on a participatory agenda involving local communities. It also engages local governments in policy analyses for NRM.

Similarly, the Mashreq-Maghreb Project led by ICARDA in collaboration with IFPRI and with the participation of farmers and herders, searches for sustainable crop-livestock integrated production systems in the low-rainfall areas of eight countries in WANA. Project scientists also address governmental policies and collective property rights in rangelands. Technology dissemination takes a participatory approach from the community level.

Enhancing human resources through partnerships

One of the greatest values of partnerships is the rich pool of expertise they can bring to bear on difficult problems. IITA, for example has been able to leapfrog forward in its biotechnology capability through a unique affiliation agreement with Australia's Centre for the Application of Molecular Biology in International Agriculture (CAMBIA). CAMBIA staff travel to IITA for periodic secondments, but still retain their home base and research programs in their lab in Australia.

Traditional linkages: partnerships in research for development

Along with all these innovations, the CGIAR continues to benefit from some tried-and-true avenues of partnership. All Centers play key roles in research networks covering a broad range of regional and topical themes. These webs of partnership link us closely to national program scientists, NGOs, farmers' and community groups, and the private sector. The CGIAR also participates in many bilateral programs aimed at strengthening particular countries.

As these efforts have strengthened national programs over the years, we find that our partnerships grow to increasingly reach an equal footing. The Rainfed Lowland Rice Research Consortium and the Upland Rice Research Consortium convened by IRRI, for example bring together the impressive resources of China, India, Thailand, The Philippines and other strong national systems from which Centers have as much to learn, as to offer.

Conclusions

Mr. Chairman, during the time of Ismail Serageldin's leadership, we witnessed a blossoming of partnerships deep and wide across the System. It is a tribute to him, to the tone and style he put into place, that there are now so many vigorous and productive partnerships that I could only begin to describe a few during these brief moments. We will always remember and honor him for this major contribution. Ismail, you have made us proud.

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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: biotechnology and information/communication technologies.

If these new tools indeed fulfill their promise, we can only hope that they bring a more just, prosperous and equitable society – one that will also have gained the wisdom, knowledge and resources to bring the population and environmental degradation monsters under control. If so, then the fruit of the Green Revolution will be a harvest richer than we had ever dreamed.

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An Assessment of Technology Development from the Green Revolution to Today

William D. Dar and Mark D. Winslow[1]

1 November 2000

ABSTRACT

During the late 1960s/70s, 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 avoided just in the nick of time through the hard work and dedication of international and national researchers working closely with government officials, agricultural ministries, extension services, non-governmental organizations, and related agencies.

This success story remains one of the shining achievements of our time. But the very architects of that revolution cautioned the world not to take it for granted, that it would be difficult if not impossible to repeat. While the Green Revolution had bought time, it could not derail the collision course between population growth and food production.

After the initial production leap due to the Green Revolution, the 1970s/80s were a period of steady but less dramatic progress, as researchers consolidated the gains of the high-yielding varieties by improving their resistance to abiotic and biotic stresses, their eating quality, and their agronomic traits, and assisted national programs in furthering their extension to the farm.

With the food problem seemingly under control, the world's attention shifted to other issues such as environmental degradation, social equity, and poverty. Some even became suspicious of the Green Revolution, providing some evidence that wealthier farmers with larger, high-quality land holdings and access to inputs were more able to capitalize on the new technologies, leaving the rural poor further behind than before.

In response, researchers were asked to take on the very challenging objectives of using technology to improve equity, decrease gender gaps, and bias benefits towards the poorest of the poor living in marginal production areas. In many ways these issues were more difficult than the original Green Revolution technologies, and the gains were likely to be much less dramatic and slower in coming. Despite these initial doubts, impacts in these areas are now emerging as substantial and well targeted towards poverty reduction.

At present, many are pinning their hopes on biotechnology and information/communication technology to provide another major jump in production comparable

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to the Green Revolution. 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 lie in adapting the cropping system to environmental diversity, making the most of the different natural resource endowments of different agro-ecozones rather than homogenizing the environment through costly inputs.

The Green Revolution – what and how

It is difficult to express superlatives that adequately convey the significance of the Green Revolution for humanity. If it had not occurred, an extra billion people would be hungry today (Conway and Toenniesssen, 1999). It enabled productivity enhancements that doubled global production of the major cereal grains, causing prices for these staples to decline by more than 70 percent in real terms since the 1970s. This global benefit was of especial value to the poor, who spend a higher proportion of their incomes on food than do the wealthy.

The origin of the Green Revolution can perhaps be traced all the way back to the 1940s, when US Vice President Henry Wallace, a maize grower himself and former Secretary of Agriculture, persuaded the Rockefeller Foundation to add agricultural research to its agenda for helping less-developed nations, particularly to find ways of raising crop yields.

The Rockefeller Foundation sent a small team of agricultural researchers to Mexico in 1945 led by Norman Borlaug, who successfully developed the shorter, much higher-yielding wheat varieties that markedly increased wheat production around the world in subsequent decades. I would like to call special attention to the scientific contribution of Japan, because the Japanese rice variety 'Norin 10' was the source of the dwarfing gene that researchers at Washington State University and later Borlaug's team used to reduced plant height.

Rice researchers such as Peter Jennings and Hank Beachell achieved similarly spectacular success by breeding semi-dwarf indica rices, made possible through the support of both the Rockefeller and Ford Foundations when they established and provided funding to the International Rice Research Institute (IRRI) from 1960 onwards. The world-leading rice knowledge base assembled by Japanese researchers contributed substantially to the achievements of IRRI and its partners over the years.

The press memorably dubbed the impact of the miracle wheats and rices as the 'Green Revolution'.

Dr. Borlaug was awarded the 1970 Nobel Peace Prize in recognition of his enormous contribution in helping developing countries avoid the massive famines that were predicted by leading pundits and strategists of the day (Tribe, 1991).

agricultural research-for-development 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 the yield potential of high-performance varieties. 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 locale and conditions, extracting the most efficient use of the endowment they have at hand.

To capture the benefits of integrated natural resource management, farmers will need to juggle several components simultaneously, and make complex decisions. They will need information tools and services to help them understand and evaluate the trade-offs, risks and rewards involved, and to make the most optimal decisions for their particular situations.

We are rapidly approaching the day when extension or farmer organization offices even in remote villages will be able to dial up the internet over the telephone (or even the cell phone) to obtain information on input and crop commodity prices, seed availability, weather, variety and management recommendations, pest and disease epidemic forecasts, and other valuable insights.

The same channels will 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. They will meet by videoconference to share experiences, consult additional specialists, and view field situations. Just as quickly as they were formed, these teams will disband once the problem is solved, free to move on to other challenges and teams, amplifying the social benefits derived from their skills.

Conclusions

It may not be surprising that an achievement as consequential as the Green Revolution resulted in such diverse and far-reaching outcomes as those described in this paper. But its ramifications continue to affect the lives of citizens, nations, regions, and the globe to this day. Surpassing the expectations of most, yet 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 the power of science in service of development – which we at ICRISAT call 'Science with a Human Face.'

Legacy of the Green Revolution: high expectations

The Green Revolution set a high bar of achievement that quite possibly may never be surpassed. Nevertheless, it 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?

Biotechnology

The promise of biotechnology to increase crop and animal productivity while reducing pest, disease and environmental stress losses is enormous, as summarized by Serageldin and Persley (2000). 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. Gordon Conway of the World Bank (Conway, 1999) argues that biotechnology can spark a 'doubly green revolution' that can add further productivity gains while also protecting the environment - IF the world community provides the essential support to ensure that it is directed towards 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 towards the orphan crops of the poor, even though the private sector may have little interest in applying them towards these crops. These basic enabling technologies need to be made available so that public-sector organizations can use them to deliver their promise to the poor (Serageldin, 1999).

Here we see a key role for International Centers in the future, as neutral facilitators or 'brokers' in helping negotiate the necessary arrangements between the public and private sectors. The Centers are trusted by both parties since they are independent of political or profit motives, and have historically proven their effectiveness as 'bridges' and 'catalysts' in partnerships between North and South.

The recent trend towards investments by the private sector in public-sector research (described earlier) is a hopeful indicator that a new era of common understanding may be on the horizon. This spirit will be key to moving forward on more difficult issues such as the sharing of proprietary biotechnologies and germplasm. We are increasingly confident that we will be able to find win-win solutions that gain access for the poor to these powerful new tools, while not denying the reward that private sector investors understandably expect for their own risks and efforts.

Information and communication technology

The global revolution in information and communication technology holds equally dazzling potential. The more complex, system-oriented solutions required of today's

Convinced by these high-payoff investments, these Foundations sought broader international participation. The UN's Food and Agriculture Organization and United Nations Development Programme, and the World Bank led by Robert McNamara proposed the formation of a global consortium of nations to contribute to the cause – resulting in the birth of the Consultative Group on International Agricultural Research in 1971.

History has proven the wisdom of this global investment. James Wohlfenson, President of the World Bank, characterized the CGIAR as "one of the most successful partnerships in the history of development in terms of scientific advances, training and capacity building, and agricultural development" (Shah and Strong, 1999). A major independent review of the CGIAR system in 1998 concluded that "there can be no long-term agenda for eradicating poverty, ending hunger, and ensuring sustainable food security without the CGIAR."

While acknowledging their role, it is important to emphasize that the Green Revolution was by no means an accomplishment of these international centers alone. It would never have occurred without the strong actions of national and local governments and research and development agencies, as well as NGOs and the private sector. Tribe (1994) lauds M. S. Swaminathan's role in India and cites Norman Borlaug's praise for that country's national research system, which Borlaug stated was "largely responsible for the wheat revolution in India".

Outcomes of the Green Revolution

Return on Green Revolution research investments

In global terms, the Green Revolution doubled the production of rice and wheat between 1960 and 1990, including a 37% increase in per-capita production (McCalla, 1998). Even the developed countries benefited handsomely as they adopted and adapted these new plant types to their own temperate-zone environments. The added value of production to the United States, for example was estimated to exceed $3.4 billion from 1970 to 1993 (Conway and Toenniessen 1996).

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 (2000) 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 percent, which is well in excess of returns for non-research investments. It also found that the inclusion of a research component in agricultural development projects increased the chances of success of such projects.

A comprehensive meta-review of 628 case observations from 294 publications on agricultural research and extension found an average rate of return on investment of 48% (Alston et al.1999, cited in Asian Development Bank 2000). This is an impressive return by any standard. At ICRISAT, we found that our top 20 research themes were generating internal rates of return averaging 39 percent by 1994 (Kelley et. al. 1995).

Economic studies found that the Green Revolution's benefits extended even beyond the lofty objective of feeding the teeming masses of poor. They demonstrated that agricultural development was functioning as an 'engine of economic growth' that broadly reduces 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 feeding back benefits in terms of greater accessibility of goods and services such as education and health care.

Expressed at the human level, many of us who grew up in poor rural households 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.

Poverty and hunger reduction

Ironically, the stunning achievements of the Green Revolution were perhaps never fully appreciated by the world community, because its very success saved the planet from experiencing the horrible consequences of mass starvation. 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. As noted by Serageldin and Persley (2000), "The paradox is that despite the increasing availability of food, there are about 840 million people, or 13 percent of the global population, who are food insecure." This food insecurity is concentrated in developing countries, with a regional breakdown led by Asia in both numbers and proportions (48 percent 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 (Tribe, 1994). 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. It became clear that the CGIAR needed to retarget its goals towards poverty reduction (CGIAR, 1997). This required a clearer understanding of whom the poor are, and the marginal environments in which they live.

Equity

Studies have disagreed on the equity consequences of the Green Revolution (Tribe, 1994). Some argue that it caused the rich to get richer, and the poor, poorer. Cases

across their TV screens during the nightly news, have now turned their attention inward on their own economic problems and development objectives. As succinctly stated by former US President Richard Nixon, "there are no damn votes in foreign aid."

Developed countries need to realize, though that spillover benefits to their own agricultural prosperity from research carried out in the developing world have far exceeded their investments in it (Pardey et. al. 1996; Tribe, 1991). The giver has been truly gifted back many times over. And far from posing a competitive threat, by helping the poor escape poverty they will be creating vast new markets for their own export goods.

Nor are the developing countries according sufficient priority to this topic. For the period 1981-85, Tribe (1994) estimated that developing countries invested only about 0.41% of the value of their agricultural gross domestic product in agricultural research, less than a fourth of the typical 2% investment made by developed countries.

Developing-country leaders, motivated by needs for urban political support, sometimes choose shortsighted policies that penalize the agricultural sector by keeping food cheap through subsidized imports. If these subsidies were instead invested in research to increase the productivity and competitiveness of their own farm communities, they could obtain cheap food internally while generating employment and enabling agriculture to serve as an engine of national economic growth, benefiting the urban population as well.

To rekindle the fire of the Green Revolution, the global agricultural sector will 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-for-development.

Towards this end, for example the CGIAR System recently agreed to preface itself with the more evocative name of 'Future Harvest Centers', and create a unified public image through a Future Harvest global awareness campaign. This campaign attracted the advocacy of world personalities such as ex-US President Jimmy Carter, Mohammed Yunus, M. S. Swaminathan and other notables.

Future Harvest also sponsors studies of the contributions of agricultural research to broader society, such as a recent assessment by the respected International Peace Research Institute of Oslo, Norway (downloadable from the internet at http://www.futureharvest.org/peace/PRIOReports.html) that reviewed the causes of conflicts across the developing world, leading to the clear conclusion that the alleviation of hunger and poverty is essential for achieving peace and stability.

The message we must convey is that everyone today lives in an interconnected world, so investments in development protect us all from the suffering and strife, terrorism, pollution, and other ills that command the public's prime attention today.

and scope during the past decade. Steadily, the array of global, regional, national, local, public and private institutions engaged in agricultural research and development are interlinking themselves in an ever-tighter fabric of partnerships, sometimes characterized as 'a fragile web.'

The closest partners for the CGIAR system remain the government research and development agencies responsible for national priorities in the agricultural sector. We are also seeing a rapid strengthening of partnerships with non-governmental organizations (NGOs) and the private sector. Being closely focused on near-term impact, these partners are helping us and our national research colleagues translate our findings quickly into impact on the ground. It is a symbiotic relationship – they depend on research organizations as a source of new technologies, and we depend on them to tailor these to fit national and local needs and share them with farmers – and very importantly, to feed back to us the needs and priorities voiced by farmers, so we can better guide our research agenda.

As an example of the dynamism and evolution of these partnerships, the private breeding industry in India has recently begun 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. Our sister Centers CIAT and CIMMYT have also garnered support from the private sector in Latin America.

The amounts of these contributions are modest, and will not be able to come close to replacing public-sector investments. And the private sector's main focus will continue to be on cash crops, rather than the orphan crops of the poor that we concentrate on. Nevertheless, we view these tangible signs as an important vote of confidence in these partnerships, boding well for the future.

After the Revolution: public attitudes towards agricultural research-for-development

In some ways, the choice of the label 'Green Revolution' was unfortunate, because it caused the public to expect a continuing series of spectacular miracles rather than the steady, painstaking progress that is the more realistic outcome of research-for-development (Tribe, 1994). There is a convincing body of evidence that steady progress and massive benefits to the poor have continued since the glory days of the Green Revolution, yet this progress no longer captures the public imagination in the way that those earlier achievements did.

Between 1980 and 1990, agricultural development investments as a percentage of total world development assistance fell from 20% to 14% (Tribe, 1994 citing IFPRI), and continued to decline in the 1990s. Developed countries, once alarmed by the impending calamity of global famines and haunting, skeletonized faces of starving babies cast

have been reported where modern varieties led to mechanization that displaced labor, and forced smallholders to sell out to larger landowners. But other studies, particularly of rice farmers in the Philippines and wheat farmers in the Punjab of India, found the opposite – that employment was stimulated, that economic gains occurred across income levels, that landholdings remained as before, and that add-on economic benefits to rural villages spilled back to further benefit farm families.

No doubt both realities have some truth to them. It would have been unreasonable to expect such a fundamental advance to have only simple, uniform consequences for all. In some cases, progressive farmers took advantage of the new technology more aggressively than did their neighbors, and their advantage was enhanced if they had greater access to land and capital. In other situations, where these advantages were absent and/or greater social cohesion and legal structures bound farmers to a collective destiny, the benefits were more equally shared. One should be cautious in making value judgments about these outcomes – both can be seen in strongly positive lights, as well as carrying their own drawbacks.

After the Revolution – a broadened agenda

Like the NASA space program, over time the glittering achievements of the Green Revolution came to be accepted as an everyday reality, and the world began to ask, 'what next?' The CGIAR was urged to expand its agenda to solve poverty, hunger, equity, and environmental problems.

Wolf (1986) admirably summarized the mood of the time, the tasks left undone, and the broadening of the agenda. He pointed out that many subsistence farmers on rainfed lands were yet to benefit from improved varieties, especially in Africa. 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 agricultural lands had missed the Green Revolution party. In India, for example, long associated with the Green Revolution, there remained 184 million rural poor in 1993, of which 84 percent lived in less-favorable, rainfed areas, accounting for 40% of total agricultural output (Asian Development Bank, 2000).

These marginal areas and neglected peoples were the source of rapid population growth and environmental degradation and should now become the prime targets for rural development, Wolf argued. But these farmers could not afford, nor would it be environmentally wise for them to adopt the high-input packages of the Green Revolution. Much could be learned from their traditional practices based on more ecologically-friendly principles such as shifting cultivation, intercropping, and tailoring the crop and crop management system to local conditions, rather than homogenizing the environment to suit the highly-bred crop.

Even in advance of this global awakening the CGIAR had increased its investment in research targeted towards marginal environments, including the creation of our Center,

the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and our sister Center ICARDA (the International Center for Agricultural Research in Dry Areas). Other sister Centers also increased their attention to marginal rainfed environments and peoples. And several more Centers were added to the System to focus on a broader range of ecological issues and approaches, including agroforestry, forestry, water, fisheries, and livestock.

Marginal environments – a wise investment?

The wisdom of relative investments in favorable versus nonfavorable or marginal environments has been a controversial issue since the mid-1980s. 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 there. Returns to productivity research in favorable areas are beginning to level off or even decline, as sustainability issues confront some key areas such as the high-yielding rice-wheat systems of the Indo-Gangetic Plain of South Asia.

Progress in the more difficult marginal areas has, understandably, taken decades to bear fruit. But it is often forgotten that the impact of the Green Revolution gained traction not earlier than two decades after Rockefeller's initial investment in Mexico. In only a slightly greater time frame, CGIAR and partners' investments in marginal lands are now beginning to pay off handsomely, despite the greater complexity of the challenges and harsh variability of the environments.

Recent evidence such as the econometric analysis of district level data in India by Fan and Hazell (1999) 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 Asian Development Bank (2000) 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."

For example, even small 'micro'-doses of inorganic fertilizers combined with local sources of organic matter and simple tied ridging to enhance on-site water retention can give large and profitable cereal yield increases in the semi-arid tropics of West Africa (Sanders et al. 1996). Yields of millet, the zone's most extensively grown cereal, can be doubled or even tripled through tiny applications of phosphorus and nitrogen, even in these hot, dry, sandy soils (Bationo and Lompo, 1999). Contrary to conventional wisdom, correction of fertilizer deficiencies with small doses in such environments reduces rather than increases farmers' risk by improving crop vigor and hastening maturity to better escape drought.

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 enabled them to be inserted as a second crop before or after cereals in the

dry tropics of South Asia, substantially raising farmers' net incomes while diversifying their operations and making them more sustainable (Bantilan and Parthasarathy, 1999; ICRISAT, 1996).

Gender equity

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. Tribe (1994), citing a World Health Organization report, summarized the dilemma faced by women. They 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.

Although not consciously targeted, researchers found that many effects of the Green Revolution were positive for women. Paris (1998) reported that the new varieties increased the demand for female hired labor because of more intensive crop care requirements. Weeding, harvesting and postharvest operations were found to be activities that employed more women than men.

Similarly, the adoption of improved groundnut production technology packages significantly increased the use of female hired labor, and helped to provide new income channels through 'task specialization' (Kolli and Bantilan, 1997). As examples, the introduction of chickpea in the 'Barind' zone of northwestern Bangaladesh provided a new income stream for women who harvest the top twigs for consumption as a fresh vegetable (ICRISAT, 1996). And early-maturing pigeonpea varieties in Kenya are enabling women's cooperative members to harvest high-value green peas for fresh-frozen export to the UK, earning a high income (ICRISAT research in progress).

Kolli and Bantilan (1997) found that women also highly value reductions in drudgery and occupational hazards, in addition to enhanced income. This illustrates the need to take a broader view of poverty than simply economic advancement.

Partnerships

The broadening of the CGIAR's agenda during the late 1980s/1990s put major strains on its capacity to deliver. Funding had not increased in proportion, and many thought that the System's reach now exceeded its grasp.

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

As a result, partnerships among international, regional, national, public and private, governmental and non-governmental organizations grew rapidly in number, diversity,

Christmas Message

ICRISAT-Patancheru
15 December 2000

My Dear family at ICRISAT,

I am very happy to give you a message on the occasion of my first Christmas as Director General of this august Institute. I am sure you will understand that being with one's immediate family during this holy season is important and compelling, and it is for this reason I cannot be present with you when you formally bring the message of Christmas to ICRISAT this year. I assure you that I will be with you in spirit, and will pray that the Christmas function is carried out and appreciated with much joy and happiness.

Christmas 2000 is an extra special one, because we are celebrating the 2000th birthday of our Lord Jesus Christ. This is a landmark year. In the last 2000 years Christianity has spread to every corner on earth, demonstrating that our fellow humans recognize and adopt the deep truth and goodness taught to us by Jesus. We are honored to spread the message of truth and keep it alive, and to celebrate on this very special occasion.

When Jesus was born the heavenly messenger brought "Peace on Earth" to people of goodwill. Peace is a much sought-after need. Without peace the mind is not free to pursue higher ideals. When we love our fellow man we nurture peace and goodwill. The same God-given love inspires us to carry out ICRISAT's mission to increase food security, reduce poverty, and protect the environment. Jesus Himself endorsed the importance of Love. So, we are privileged to carry out our mission at ICRISAT knowing that it is blessed with divine approbation, and that we are actually carrying out a labor of love. Let us be thankful and joyous for this knowledge.

This Christmas I wish each of you and your families PEACE.

I wish you JOY in your work, that will carry you strong and smiling into the New Year.

And above all, I wish you LOVE.

Merry Christmas and a Happy New Year. God bless you.

The same approach applies to South Asia, where the CGIAR has just endorsed that ICRISAT convene the inter-Center effort. This idea was discussed with APAARI, the regional forum for the Asia and the Pacific, and was warmly received and they are ready to enhance this process. We were also pleased to host the visit of the DG of the International Water Management Institute (IWMI) recently, and we signed a Memorandum of Understanding to initiate cooperative activities in natural resource management and policy research on water resources.

This spirit of closer regional cooperation was also endorsed by our donors and by the entire CGIAR System in Washington, just three weeks ago. The entire CGIAR is now feeling the urgency of change, and we should lead, not follow this imperative.

Coming to the national level, we revitalized our relationship with ICAR in June through our JIIPAC meeting where we signed an 'Aide Memoire' and formalized our joint partnerships. The ICAR leaders commented about how impressed they were with the large size of the visiting ICRISAT team and the clear commitment. We will follow up on progress with them on Tuesday of this week.

I'm also happy to remind everyone that this year, SADC nominated our own SMIP project to FARA as the best example of a CGIAR-NARS partnership. This speaks far more loudly than anything we can say about the quality of our partnership efforts.

Now let me turn to science. Last year I urged you to bring more focus on the human face of your science. Have we re-defined our agenda in this way? Here there are some bright spots, but there are many areas where we need to work harder.

The first bright spot of course has been the joining of Dr. Jill Lenne as DDG, to give us the crucial leadership in research that we have been needing now for three years. She will play a major role in Workplanning Week this time and I think you will see what a big difference this will make.

This year our major commitment to build a molecular breeding capacity really took off. Dr. Jonathan Crouch joined us and is very actively building a state-of-the-art lab that will have very practical applications. He has been trying to fully involve everyone and build partnerships at the same time. This area is critically important to ICRISAT's future scientific credibility, as I'm sure you all appreciate.

We have opened a number of new research positions in all three Programs. This will help us rebuild our capacity that was so badly hurt during the budget crises of recent years. This is our chance to re-invent ourselves with new blood, as we said we would do in our Guiding Principles. This is equally vital to our future, and so far we have been pleased by the high caliber of applicants.

Choosing priorities and sticking to them is not easy, but it must be done. As you know, the RMC carried out a process of re-examining the existing set of priorities during the past few months. Any such process is going to be difficult. The method we chose was to

build upwards from the Project Coordinators' ranking of priorities. We used the concept of integrated natural resource management as a framework for this assessment, with a heavy emphasis on inter-Project linkages. We factored in the judgement of the Program Directors, and also the new CGIAR Vision and Strategy with its Seven Planks including initial indications from the SAT Futures consultations where everyone was involved.

As a starting point in the process, the RMC deliberated the Center Project portfolio and decided to reduce the number of Projects to ten this year and to stay for three years. Some of you were concerned about this. I want to emphasize that RMC did not eliminate any area of work in this process; rather, it was a consolidation to streamline the agenda and reduce reporting and transaction costs.

I realize that this process can always be improved, and want to thank you for the many suggestions you made in your Program meetings. We will use that input to help improve the process next year.

At the Output level within each Center Project, I encourage Project teams this week to re-examine the set that were brainstormed and suggest changes, while not exceeding four outputs per Project, preferably less. And within each Output, you will need to define Activities this week, but not exceeding five per Output. Also to prevent fragmentation, no scientist can be involved in less than 25% time in an Activity.

During this process, I would especially encourage Project teams to be innovative, not to simply propose more of the same old things. We absolutely must renew our agenda to make it more relevant to the livelihoods of the poor, and therefore more attractive to development investors.

The famous economist John Maynard Keynes said, "The greatest difficulty in the world is not for people to accept new ideas, but to make them forget old ones." I am still suspecting that there are many 'legacy hobby horses' within our research activities, things we may have been working on for decades out of academic interest that may not really be such high priorities for helping the poor. Let us have the boldness and energy to move to a modern and impact-oriented agenda, one that will excite our partners and development investors – one that makes people stand up and take notice that things are really changing at ICRISAT!

Many ideas have come up in the course of the SAT Futures consultations; this is the time to put them into action. For example, diversifying beyond our mandate crops; nutritional breeding to directly target human welfare; combating global warming by increasing carbon in the soil; and helping Africa deal with agriculturally-related aspects of the AIDS epidemic, are a few that come to mind.

We must keep asking ourselves, what does our science mean for the poor and the hungry? If we have to stretch hard to think of a link, then we should really consider whether we are being disciplined enough in our choices. A focus on our comparative advantage – research for development – is essential.

During 2000 we have several significant achievements. I will not be able to mention these due to lack of time but it has been a productive year. I congratulate all scientists and support staff at all locations who have contributed to these achievements. But let us not forget the wise guidance and the policies enunciated by our Governing Board.

Our scientists and scientific officers have been doing excellent work in research and development, and have been recognized nationally and internationally. Since I and the Research Management Committee have faith in our scientists and support staff, we have decided to recognize outstanding contributions through an annual awards program. During the annual review and planning meeting last month we announced the winners for our Millennium's first ICRISAT Science Awards.

Overall, it has been a good learning and enriching year for me, and I would like to thank all staff who have welcomed me as a family member and have given me all the support and help in making my beginning at ICRISAT so fulfilling. We have many more things to do and I need your advice and help to see that ICRISAT continues to be recognized as the world leader and the credible research-for-development institute for the semi-arid tropics. I cannot do it alone. Let us join hands with our partners and other stakeholders and make the second green revolution happen in dry and marginal areas of the world. Let us build our tomorrow together, because we have the vision and the unity to achieve our common goal.

Thank you

achieve synergies in these fields, with the support and patronage of the Hon'ble Chief Minister.

- And we are proud of our International School of Hyderabad, which provides a world class basic education not only for our children, but for many of the IT companies attracted through your initiative to Cyberabad.

I would now to like address ICRISAT staff members on the occasion of the Annual Day. After my joining in January, I have been engaged in knowing more about our ICRISAT family across all locations in the world. The year has also given me a great opportunity to learn more about the life of poor farmers in the semi-arid tropics or SAT as we call it.

During my address on 12 January 2000, I mentioned that the research we do, in cooperation with our partners, which is science with a human face, must benefit these farmers – and the poor people living in dry areas. Today I am glad to state that the Institute has adopted wholeheartedly the motto of "Science with a Human Face". I wish to emphasize that these words have great significance, because they give a meaning and purpose to our work. I firmly believe that research without a vision is a waste, and research without a mission is a burden.

As part of the ICRISAT family, we have to realize our vision for helping the hungry and the poor of the semi-arid tropics. I am happy to see that you have internalized our vision. The next step is to carry it out in your daily work in order to fulfill it. ICRISAT's vision is an integral part of the overall vision and mission of the Consultative Group on International Agricultural Research (CGIAR): A food secure world for all.

Another area that I wish to emphasize is unity. Unity, which we have in the Institute, is very critical in achieving our mission. We must enhance to work together towards this common goal. Many of you have heard of the story of the father and sons who wanted to go their separate ways. He showed them how it was easy to break one wooden stick, but was difficult to break a bundle of four to five sticks. We must be united as a family and thwart the external forces that threaten to divide us. We should stand united to live in an environment that is highly challenging and competitive. For this we must be willing to respond to the needs of our clients (poor farmers) and the external environment. We must prioritize and choose areas of work that are a high priority to the Institute — not to individuals.

We have to make hard choices with limited resources. Our research project teams have to be innovative. We should have the boldness and energy to move to a relevant and impact-oriented agenda, one that will excite our partners and development investors. We must keep asking ourselves, what does our science mean for the poor and hungry? A focus on our comparative advantage – research for development – is essential. We have to change to a 'lean' culture, so that we will not only be more efficient, but also gain more confidence from our investors.

The new Chairman of CGIAR, Mr Ian Johnson is committed to the cause of CGIAR, and has initiated plans to make the system more sustainable. I am happy to mention that Dr Johnson plans to visit ICRISAT in February 2001.

Now I would like to turn to a discussion of our funding. Here we still need to make progress. I do realize you have all made major efforts in recent years, but the reality is that our total budget is not increasing. Our core donors are still showing fatigue, and the only way forward is to attract more special projects.

I have asked Dr. Lenne to make this a special point of focus in her first year. She will be discussing this with you at length this week, and will be assessing our project development process in its entirety. Of course, she will need the help and commitment of all of you if we are to achieve real change.

In addition to raising our grants, there is a pressing need to become more efficient in utilizing our precious resources. We are perceived by some outsiders as a System that is lavish and opulent. We have to change to a 'lean' culture, not only so we are more efficient, but also so that our friends change this image of us and gain confidence that their investments in us are truly well spent.

Continuing on the theme of changing our image, you will recall that I emphasized very strongly last time that public awareness needs to be everybody's business across ICRISAT – that we are all spokespeople for the entire organization, and we need to promote that positive image of 'Science with a Human Face' wherever we go. I am very pleased at the efforts you have all made so far.

To name just a couple of examples, I have seen that our field demonstrations have improved enormously, and we are getting in many more newspaper and TV articles. These results are visible to all and we have gotten a lot of praise from many of our visitors and partners.

Again though, I am sure you understand that raising our image will be a long term process. We are off to a great start, lets build on it!

With these points on the table, let me repeat that based on what I have observed this year, I have developed a very solid confidence in you, our scientists. We often speak of resources, thinking of operating funds; but the resources of greatest value to our clients are, by far, yourselves. You are the front line. We will either succeed or fail based on your creativity, your effort, your teamwork, and your sense of mission. And I am sure you can handle the challenges, great as they may be.

And to further emphasize this faith, I and the RMC have decided that we should recognize outstanding contributions through an annual awards program. We will model this after the CGIAR Chairman's annual awards, because we believe that the staff members we choose to submit for that consideration, deserve the highest internal recognition whether or not they are chosen in the Systemwide selection process. And we feel it is important to add an additional category – best research team – to the five categories of the CGIAR.

Therefore I am proud to announce the following winners for our Millennium ICRISAT Science Awards:

Outstanding Young Scientist: Philippe Delfosse

Outstanding National Scientist: Ranajit Bandyopadhyay

Outstanding National Support Staff: Eric Manyasa

Outstanding Partnership: Sorghum and Millet Improvement Program

On this happy note, I would like to close. I thank you all for the time and effort I know you will give in the coming days. Let us not underestimate our role – the well being of millions of desperately poor in the SAT can be positively influenced by the ideas and commitments we make this week. I believe that there is no limit to what ICRISAT can achieve with its intellectual power much more to help the poor. They deserve the best effort you can muster – and they expect nothing less.

Thanks – and good luck!

For the benefit of the Hon'ble Chief Minister, I would like to mention a few points relating specifically to partnership between ICRISAT and Andhra Pradesh:

- In response to the requests from the State Government of Andhra Pradesh, we provided assistance to implement watershed-based technologies for water harvesting. More recently, ICRISAT responded positively to address the groundnut bud necrosis virus epidemic in Anantapur district. We have agreed to provide seeds of ICRISAT-developed groundnut cultivars with resistance to bud necrosis disease. We also submitted a joint funding proposal to the National Agricultural Technology Project (NATP) to conduct further need-based research in this area.
- ICRISAT as an employer provides jobs to around 700 staff, 196 RWF or Regular Work Force, and 300-450 (during peak period) TFL or Temporary Farm Labor. The salary and wages are at least 20% higher than comparable jobs in the State Government or ICAR.
- ICRISAT has provided housing loans to staff and RWF, and has assisted in developing the RWF colony at Bheeramguda, near Patancheru.
- Early this year, we initiated an "Adult Literacy Program" for the RWF to mold them to be better citizens.
- The ICRISAT Association for Community Development (IACD) is involved in social work to uplift the poor in the community around ICRISAT Campus. The young girls and ladies from surrounding villages are provided vocational training in tailoring, etc., and also adult literacy programs.
- IACD runs a clinic (medical, dental and ophthalmology) to provide free medical service to the community.
- ICRISAT has always volunteered to serve the less-fortunate people during natural calamities by providing help, food and clothes, seeds, etc. whenever called for.
- We made major efforts in public awareness this year, and the results have been clear for all to see. When I arrived (in January this year) many people in the Hyderabad community told me that ICRISAT was invisible. Now they are telling me that they are seeing us in the newspapers all the time. I am pleased that we are becoming better appreciated for the Science with a Human Face that we do.
- We are also making steady progress in knowledge sharing and information technology to help our work become more efficient. I want to commend the Chief Minister for his forward-looking policies and we would like to explore further with him how we might team-up to use information and communication technology to better reach the poor farmers so they can increase their food security and farm income including other livelihood opportunities.
- ICRISAT is involved in two of the three emerging technologies flagged by the Hon'ble Chief Minister—Biotechnology and Information Technology. ICRISAT has always prided itself in being close to Cyberabad for adding value to science using the available expertise on information technology. I feel we should work together to

Year 2000: A Productive Year For ICRISAT

ICRISAT-Patancheru Annual Day Address
7 December 2000

Honorable Chief Minister of Andhra Pradesh, Shri Chandrababu Naidu, Chief Secretary, Shri P.V. Rao, Joint Secretary Shri Laxminarayana, Assistant Director General Mr. S. Parthasarathy, Chairman of the Annual Day Committee Dr C L L Gowda, Members of the Press and Media, well wishers and friends from Hyderabad, Rangareddy and Medak, members of ICRISAT Management Group and staff, Ladies and Gentlemen;

Good morning to you all. We are gathered here today for the first Annual Day in the new millennium, and also the first for me as the Director General. I am very glad that the Hon'ble Chief Minister is with us as the Chief Guest, along with Chief Secretary and Joint Secretary, for the function. I would like to profusely thank the Hon'ble Chief Minister for all the wonderful support from the state government and other institutions that have helped enormously in our mission. This support has enabled us to help the semi-arid tropics (SAT) farmers in Andhra Pradesh and elsewhere in India find environmentally sustainable, safe and profitable technologies to increase crop production.

For the first time in the history of ICRISAT we organized the India-ICRISAT Day on 15 November 2000 to commemorate the partnership and joint impact of collaborative research on Indian agriculture and the benefits accrued to poor farmers in India and other parts of SAT. The deliberations at this meeting clearly demonstrated the joint efforts in improving the SAT farmers in different areas of India, including Andhra Pradesh.

The Future of SAT Agriculture and ICRISAT

International Symposium on the Future of Agriculture in the Semi-Arid Tropics, ICRISAT-Patancheru
14 November 2000

Let me extend to you all a warm and hearty welcome this morning to this very important International Symposium on SAT Futures. We are indeed fortunate to have with us today a panel of internationally renowned scientists, leaders, policy makers, and experts from a wide spectrum of national, regional and international organizations. I would like to make particular reference to the presence of Dr. Kurien, a World Food Prize Winner, who, as we all know has pioneered the White Revolution in this part of the world with a replicable model of development that has become a household word and beacon light to the rural farmers in the developing countries.

ICRISAT, has the global responsibility for agricultural research in the Semi-Arid Tropics, known as the SAT. Home to one-sixth of the world's population, of which half lack access to even basic health and nutrition, SAT includes parts of 48 developing countries in Africa and Asia 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. It is against this backdrop that ICRISAT began its work 27 years ago.

Since then, ICRISAT's team of highly committed scientists has been tirelessly pursuing the mission of helping the SAT farmers to apply science to increase crop productivity and bring about food security, reduce poverty, and protect the environment. Significant strides have been made in enhancing agricultural productivity through genetic enhancement, and preserving crop diversity the world over, particularly in the SAT regions. Over 113,000 germplasm accessions from 130 countries are held in trust by ICRISAT for the international community. We have played a very important role in strengthening the national research programs and grassroot level institutions. Our natural resource management research has achieved a great deal of success in managing scarce water resources, augmenting soil fertility and attacking growing desertification in the fragile SAT ecosystems.

Much remains to be done to bring about any significant impact on the problems of food insecurity, poverty and environmental degradation in the SAT. Without a long-term strat-

egy to attack the seemingly intractable problems and challenges ahead, we realize that the journey towards fulfilling our mission is going to be extremely difficult. Studies have been underway by our policy research team to develop base documents and framework for analysis for charting the future of agriculture in the SAT and analyzing critical issues - trends in SAT agriculture, emerging constraints limiting growth, food security and environmental sustainability over a long term horizon of 20 years.

This initiative is expected to provide a foundation for identifying agricultural research and development priorities relevant to ICRISAT and its stakeholders in the future. The studies will also pave the way for analysis of the possible roles of ICRISAT, other international Centers, NARS, NGOs and the private sector in implementing research and developmental activities in the SAT; priorities for institutional development; and the requirements for strengthened partnerships.

ICRISAT commissioned two experts of international repute - Dr. D.S.C. Spencer from Sierra Leone and Dr. J. G. Ryan from Australia - to develop a white paper on "Challenges and Opportunities Shaping the Future of Agriculture in the Semi-arid Tropics and their Implications", dwelling on, among others,

- trends, projections and implications of key agricultural and socio-economic statistics/ issues in the SAT region
- dimensions of poverty and their implications; and
- key challenges and opportunities in SAT regions

This extremely important initiative is a part of a three-phased action plan.

Several rounds of brainstorming sessions have already been held at the regional level, across Asia and Africa. Today's symposium where we have an assemblage of eminent international panelists signifies an appropriate finale to this highly successful and rewarding consultative phase.

The emerging white paper will be a critical input into the Institute's Long-term Strategic Plan, a '2020' vision of ICRISAT and SAT Agriculture, to be developed in the final phase.

Food availability, food access and nutrition are three dimensions of food security, which are 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 ICRISAT's vision has to extend to encompass the entire gamut of the issues - on water, soils, pests, crops-livestock integration, carbon sequestration, health and nutrition, post-harvest technology, rural livelihoods and augmenting income and purchasing power of the poor and so on – it is a formidable list of challenges which can be tackled only with Science with a Human Face.

What is heartening to note is that this momentous and ambitious initiative has been receiving a great deal of attention all around, including positive notice from the

- Most of the hybrid sorghum grown in India has some degree of parentage contributed from breeding research done jointly with our partners.
- A pigeonpea variety, 'Maruti' is resistant to the devastating wilt disease caused by the Fusarium fungus, and saved many small farmers in Karnataka, Maharastra and Andhra Pradesh from disaster over the past decade.
- Together we changed the plant type of pigeonpea to a much shorter plant that yields its grain much earlier in the season, netting farmers much higher incomes.
- Pigeonpea and groundnut farmers in southern India have greatly reduced the use of insecticide, up to 100% on some farmer's fields, protecting their health and the environment.
- In Maharashtra a high-yielding ICRISAT variety of groundnut, and adoption of the broad-bed-and-furrow system of planting, made it possible to increase production significantly.
- New chickpea varieties that mature much more quickly to avoid drought are spreading rapidly around the country. This environmentally-friendly crop has been a livesaver for Andhra Pradesh farmers. Production has increased nine-fold over the last ten years in this State.
- ICRISAT has trained almost 1,000 Indian students and scientists in all these research areas.

While recognizing these achievements, let us remember that they could not have come about without the additional partnership of development investors, who provided the means for carrying out our work. They used to be called 'donors', but now we call them 'development investors' because they are increasingly activist partners. This is clear by the presence of a number of them here today.

In closing, ladies and gentlemen, let me sum up all that I've said in just a single phrase: the power of partnerships. Today is our chance to appreciate the power that our partnerships have shown: what they have achieved, what remains to be done, and to recommit ourselves to the path forward.

And it is the chance to offer our sincere thanks and appreciation to our partners, especially to the Union Government and its Ministries and Departments, and to the State Government of Andhra Pradesh. And also to the Governments of all other States of India with whom we work. We admire and respect your commitment and dedication, and we promise to continue to work shoulder-to-shoulder with you in the same spirit.

For with all that we have achieved – and we know that we have helped save millions from hunger already – there are still millions more still living in quiet desperation. We are winning the battle, but the war is a long and difficult one.

Let us then today pledge to re-dedicate our efforts to win the war against poverty, hunger, and environmental degradation across the dry tropics –by working together, doing science with a human face to help people 'grow their way out of poverty'.

Thank you.

were called upon recently by the Andhra Pradesh State Government to attend to a crisis in Anantapur District together with other partners, where local farmers were faced with the devastating peanut bud necrosis virus epidemic. We also helped during the recent severe drought when the State Government asked us to provide know-how for water-harvesting technology.

We will continue to help proactively wherever we can. And I also want to put on record here our deep and sincere gratitude and appreciation for the State Government's emergency help to us in our time of crisis, when our campus was flooded during the extraordinary rains of August. There is no doubt that the Government's quick action saved lives, and we cannot thank you enough for that.

We also thank the Union and State Governments for their many forms of assistance in facilitating our non-profit, humanitarian mission and constitution. Wherever we go in India, and whenever we need assistance, we have found the Indian Government and people to be most gracious and anxious to help.

India has given of its human talent as well. Our Indian scientists have made remarkable research contributions throughout our history. The Indian members in our Governing Board have been a constant source of encouragement, wisdom and guidance, which we will always value. Starting with the doyen of the Indian Agriculture Dr. M.S. Swaminathan, followed by Dr. N.S. Randhawa, Dr. O.P. Gautam, Dr. V.L. Chopra and Dr. R.S. Paroda, Director General of the Indian Council of Agriculture Research – currently the Vice-Chairman of the Board – they all have been a great inspiration to us. The same goes through with the very dynamic Secretary of the Ministry of Agriculture of India, Shri Bhaskar Barua, and several of his illustrious predecessors, who held this office, and the Chief Secretary of the Government of Andhra Pradesh, Mr. P.V. Rao and several of his illustrious predecessors who held the office of Chief Secretary to the Government of Andhra Pradesh.

We are grateful for all these gifts of India, and we try to give back to the community and nation as well. Our largest impacts in helping the poor have been in this country. And ICRISAT is one of Hyderabad's largest employers, with about 800 staff. We have high standards and I can tell you that they are among the most hard-working, productive, dedicated staff to be found at any research institution, anywhere in the world. We know that they are the pride of the Hyderabad and Patancheru communities, and we are glad to have played a hand in strengthening those communities.

What a wonderful partnership it has been. But what has it produced? Let me briefly describe to you the cornerstone of our pride: our major joint achievements in helping the poor:

- A total of 106 improved varieties of sorghum (called jowar in Hindi or jonna in Telugu), pearl millet (bajra or sajja), chickpea (channa or senaga), pigeonpea (tur or kandi), and groundnut (mungfali or verisenaga) have been released in India, raising production and small farmer income.
- Pearl millet varieties resistant to the downy mildew fungus helped rescue pearl millet farmers from the brink of disaster during epidemics across India in the 1980s and 1990s.

Technical Advisory Committee of the CGIAR. We are fully alive to the gravity of the onerous responsibility that has been cast on ICRISAT. We are constantly reengineering ourselves to handle the challenges. We are committed to strengthen partnerships and work hand in hand with NARS and sister CGIAR centers, advanced research institutes, the universities, the private sector, NGOs, extension departments, farmers' organizations, development agencies, policy makers, and regional organizations to realize our dream of a food-secure and environmentally stable SAT.

No one understands the harsh realities of the SAT and SAT agriculture better than the eminent panelists we have here with us today. We cherish the wealth of your experience, wisdom, vision and innovative ideas. Today's session is going to be a very important learning experience for us. Let us work together and chart the roadmap to the future for the Semi-Arid Tropics as this blueprint will also spell the future and growth of ICRISAT. I hope that we will have thought provoking, stimulating and rewarding deliberations. Thank you all, once again.

India and ICRISAT: The Power of Partnership

India-ICRISAT Day, ICRISAT–Patancheru
15 November 2000

Distinguished Guests, Ladies and Gentlemen,

Before I begin, I would like to take this opportunity to condole the recent demise of Mr. C. Subramaniam – CS we have all known him – who was the harbinger of the green revolution in India, and with his wise counsel and planning turned this country from a food-deficit to food-surplus country.

It is with great pride and satisfaction that I stand before you this morning. My pride and satisfaction stem from the achievements of the long and mutually rewarding partnership between ICRISAT and India that is now in its 28th year. And let me add, India has been not only a tremendous research partner, but also a very gracious host.

The dry tropics are home to hundreds of millions of desperately poor both in Asia and Africa. Most of those poor live in Asia, and of those, the majority live within India. So it made perfect sense for us to seek a home here in partnership with the institutions of this country.

Our strategy to help India and other countries in the dry tropics is to develop new technologies to stimulate agricultural development. Our science is squarely targeted towards helping the people who need it most. We call it 'Science with a Human Face' – this is our rallying call, and you will see this motto all around you on our campus and even on our buses that cross all over Hyderabad each day collecting our staff.

I know that many of you are very familiar with what we do, but for those of you who are gracing us with your first visit, let me just mention some of the areas of research that we focus on. We emphasize the breeding of more productive varieties of the staple food crops of the poor - varieties that are resistant to pests and diseases, and higher-yielding. We look for safer ways of controlling insect pests, reducing the pesticide hazard to farmers and to the environment. And we search for ways to make more efficient use of the water and nutrient supplies of marginal soils, because plants cannot become more productive unless they are well nourished.

Of course these are very ambitious objectives, and that is why we make every effort to attract and retain the very best scientists in the world. They are all here with us today, from all of our eight locations worldwide, for our annual global planning meeting. I am very proud of them all, and you will have a chance to chat with them as you learn of their impressive achievements today.

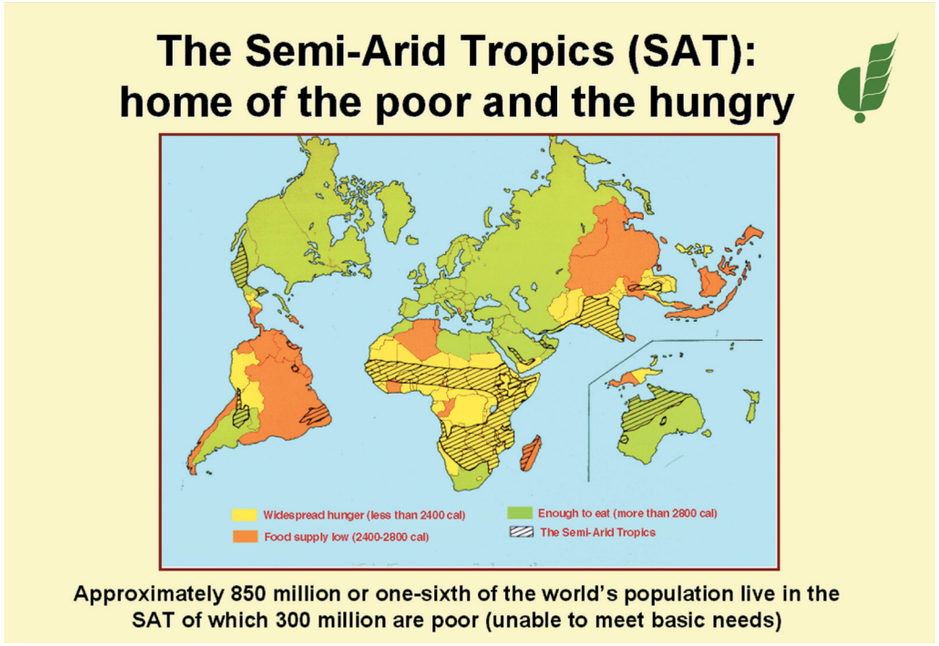
From the beginning, our partnership with ICAR has been the cornerstone of our strategy. State governments are also our key partners, because they have the extension systems that carry the new technologies all the way to farmers in every village. The impact of these partnerships has been phenomenal and has far exceeded the cost of the investment, a point I will return to later.

Today, these partnerships are even more vigorous than ever before. We meet twice a year with ICAR to review our joint projects. Together with ICAR and the State Ministries, in recent years we have been expanding the scope of our partnership to include an even wider range of organizations across civil society, including farmers' community organizations, non-governmental organizations, and the private sector. We weave all these relationships together through networks focused on particular problems. At a regional level, we participate together with India and its neighbors in a regional association of Asian national research systems known as the Asia Pacific Association of Agricultural Research Institutions (APAARI).

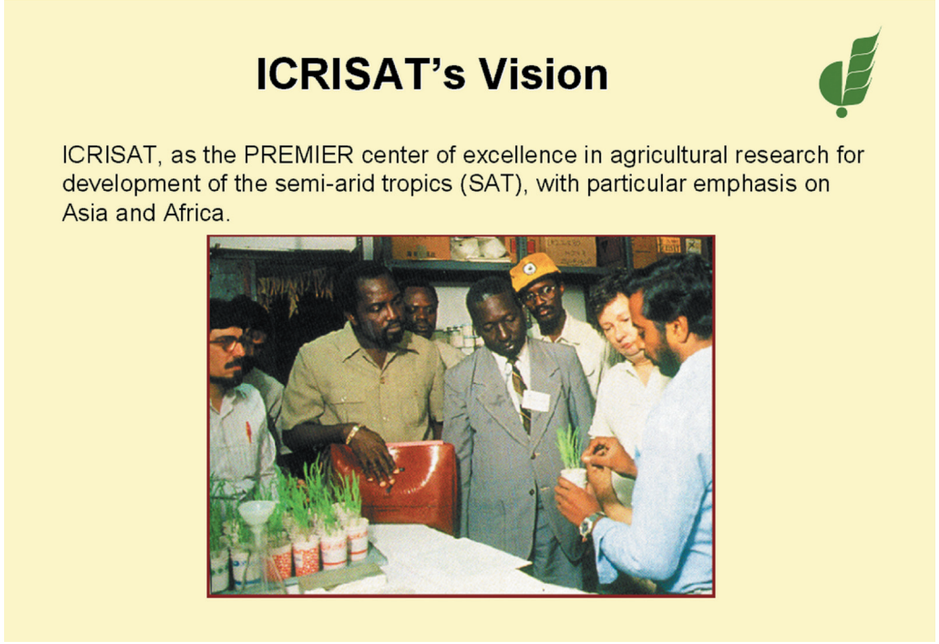
These partnerships are absolutely critical to our work. Without them, we would not have the understanding of national and local needs, nor the contacts to the local communities, that we need for our work to reach the farmers. And our partners are often better than us in fine-tuning and adjusting our technologies so that they work well in the different and special environments of local communities.

For our part, we hope that we give something back – that our ability to link our partners to international resources, to bridge information gaps and provide training and new technologies, is valuable to India. So we see our partnerships as very complementary and very synergistic. They benefit all partners.

Being hosted here in Andhra Pradesh, we feel a special relationship and responsibility with the local and State community. Although our main focus is strategic research, we



The maps of poverty and hunger, and the map of the semi-arid tropics, largely coincide with one another. We are focused on the areas where the poorest of the poor live.



Our vision capitalizes on our nature as a nonprofit, international, apolitical institution focused on science-based agricultural development of the semi-arid tropics. We insist on excellence in all we do.

Slide Presentations

ICRISAT's Medium-Term Plan, 2001–2003

– presented on 15 March 2000

Ladies and Gentlemen,

ICRISAT's rolling Medium-Term Plan for the 2001-2003 period is all about people – how we can improve their lives by reducing poverty, hunger, and environmental degradation in the dry tropics. We call this 'Science with a Human Face.'

So we sincerely invite you to join us, in whatever ways you can. Our dedicated team of scientists live and breathe their mission every day. But they are few, compared to the task at hand. We are an open institution, and seek more involvement, ideas and help from our whole range of partners. You – the development investors – are crucial to the success of the Africa Agenda. I look forward to your help in moving this Agenda forward. Thank you.

ICRISAT's Africa Agenda into the New Millennium

Ladies and Gentlemen, the CGIAR has accomplished much in Africa already, but so much more needs to be done. The scourges of poverty and hunger are still not under control. At ICRISAT, we believe that our standard for success or failure will be measured not just on the quality of our research and number of publications, but on how effectively we help people escape poverty. We call this people-first focus 'Science with a Human Face'. This is depicted in our new Institute icon, in the upper right.

Why an Africa Agenda?

- Improve coherence of Africa work
- Raise its visibility via MTP
- Make explicit our commitment
- Improve donor understanding and interest
- Provide strategic platform for consulting partners

We decided to put together our Africa Agenda in order to give a holistic, coherent view of our thoughts and ideas for overcoming the enormous challenges facing the dry tropical areas of this continent. Today I want to share that Agenda with you, and receive your feedback and ideas. I also want to suggest that you consider to continue and even enhance your participation in it, and support for it.

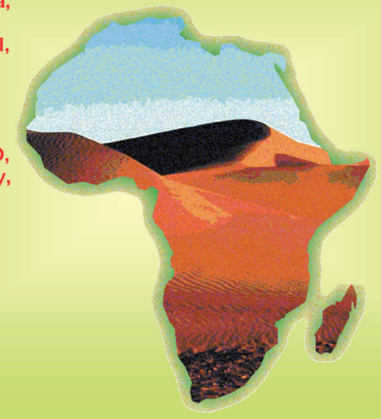
Inputs into the Africa Agenda

- Board-approved Africa Strategy (Feb. '99)
- Inputs of ICRISAT scientists
- SPAAR/CGIAR/NARS Meeting of Minds—consultations with partners (1999-2000)
- Ongoing consultations with partners via working meetings

We have been very inclusive and consultative in our approach to developing this Agenda. We consider it to be a living document, or process, and look forward to getting your inputs today, to add to those already received as shown here.

The current ICRISAT agenda in Africa is supported by

African Development Bank, Australia, Austria, Belgium, Brazil, Canada, CFC, China, Denmark, EU, France, Germany, IFAD, India, Iran, Italy, Japan, Korea, Netherlands, Norway, the Philippines, Sweden, Switzerland, Thailand, UK, USA, UNDP, UNEP, the World Bank



Eritrea
Ethiopia
Kenya
Malawi
Mali
Niger
Nigeria
South Africa
Zimbabwe

CARE
CRS
PLAN Intl.
WVI
Private Sector

We are extremely grateful to our loyal development investors, and to our developing country partners who host us and facilitate our work in many ways. The past quarter century has shown our collective commitment, and a long-term view is the only way we will continue to make steady progress against these difficult problems.

Resourcing Strategy

- Increasing partnerships
- Additional resources needed to meet the targets of the Agenda
- Donors very concerned about poverty and food security trends in sub-Saharan Africa
- ICRISAT's Africa Agenda can and will make a difference!

We need your help to carry out this ambitious Africa Agenda. We will seek to resource it first and foremost by getting the maximum synergies we can out of our partnerships, and continue to enhance them. We can and will do even more to share human resources, information, infrastructure, and other existing assets. But even with this, we will need additional financial resources as well. We hope we can inspire your confidence that we are on the right track, and that you will help us to bring these ambitious goals to reality.

ICRISAT's Comparative Advantages

- Only international agric. R&D center focused on the SAT
- Nonprofit, apolitical, science-based: unparalleled positioning to act as:
  - Bridge
  - Broker
  - Catalyst
- World's best and largest SAT genetic resources collection
- Unique depth, expertise in SAT food legume research

We believe that we must stick close to our comparative advantages, so that our partnerships complement and don't duplicate. Our combination of internationality, apolitical and nonprofit nature, together with our scientific focus, create our unique advantages, which we label as Bridge, Broker, and Catalyst. In all three roles, our advantage is heavily based on enhancing partnerships and applying good science.

ICRISAT Capacities in Africa

- Seven locations, strategically chosen
- West Africa: Bamako (hub), Niamey, Kano
- East Africa: Nairobi, Addis Ababa
- Southern Africa: Bulawayo (hub), Lilongwe
- Two thirds of internationally recruited staff are in Africa
- Scope of expertise well matched to the Agenda
- Synergies with ICRAF, IITA, ILRI

We have seven locations in Africa, plus our Headquarters in Asia. Our global project portfolio is built on a close integration of our African and Asian work. The lateral exchange of knowledge, skills, technologies, and people is an extremely fertile mix that no comparable institution can match.

Relationship of Africa Agenda to Medium-Term Plan

- Documented in Annex within the MTP

- Activities are built into the 12 MTP Center Projects

Our Africa Agenda is an integral part of our new Medium-Term Plan. The full text version is included in an Annex within that Plan document. The activities of the Africa Agenda are fully incorporated within our 12 Center Projects.

Core Focus: Poverty Reduction *through* Sustainable Agricultural Growth

- Fits poverty focus of renewed CGIAR Vision
- Reflects importance of agriculture in economic and food security of SAT poor
- Empower rural poor to 'grow their way out of poverty' through appropriate technologies, institutions, policies

We continue to believe strongly, as the CGIAR has since its inception, that agricultural development is key to reducing poverty, hunger, and environmental degradation in the developing world. In short, we believe that we can help developing countries to enable their rural poor to 'grow their way out of poverty.'

The SAT countries are malnourished. The map of the SAT largely overlaps the occurrence of malnutrition across Africa. We estimate that 80 million people in the SAT of West Africa are truly food-insecure and hungry.

SAT: Home to some of the poorest in the world

Countries in Africa	Agric. Pop. (Millions) (%)	% Agric. Land in SAT	HPI Value %	HPI Ranking (92 countries)
Niger	9.4 (88)	100	65	92
Burkina Faso	11.0 (92)	60	59	91
Mali	9.1 (81)	46	53	87
Chad	5.7 (75)	51	52	86
Senegal	7.0 (74)	46	50	80
Mozambique	15.0 (76)	66	49	79
Zambia	6.4 (69)	32	38	64
Nigeria	37.2 (33)	24	37	63
India	557.7 (55)	70	36	59

(FAO + UNDP Statistics)

The SAT countries, particularly those in West Africa, rank as the poorest in the world, according to the Human Poverty Index. This index is a comprehensive measure of quality of life including life expectancy, nutrition, literacy, access to safe water, health services, sanitation and other criteria. Out of 92 developing countries, those which are predominantly in the SAT in West Africa rank at the bottom.

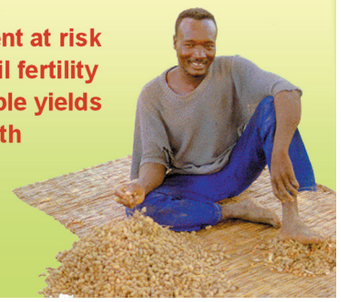
We thank Dr. Peter Cooper of ICRAF for this slide.

Germplasm and genetic resources, long a strength of ICRISAT and the CGIAR, will have major impacts as part of the Agenda.

Our approach will be inclusive and partnership-based. It will also emphasize the latest scientific tools and rigor.

Specific Research-for-Development Themes within the Africa Agenda

- Raise soil fertility and diversify, sustainably
- Solve input and market bottlenecks
- Solve seed supply constraints
- Desert margins: an environment at risk
- Legumes: equity, nutrition, soil fertility
- Cereal breeding: high and stable yields
- IPM: protect ecosystems, health
- Genetic resources: preserve and use biodiversity



With our Agenda focused on raising soil fertility, we have a number of allied objectives. Once soil fertility is raised, these additional themes create synergistic opportunities to increase and stabilize crop production and the soil, water, and genetic resources it depends on.

Major Impacts Likely in Next 3-5 Years, if Adequately Resourced

- Substantial increases in household income through enhanced soil fertility
- SAT poverty understood
- Commercialization enhanced
- Practical watershed technologies implemented
- Major pests, diseases under control for smallholders

At the end of the day, the benefits of a successful Africa Agenda will be huge. The benefits will both be at the human household level, via poverty reduction; and also at the national and regional levels, in terms of more sustainable agricultural systems, food security, and national/regional prosperity.

Agriculture and SAT Poverty

Coarse grains are more important for the poor than for well-off people

Coarse grain cereals (sorghum and millet) in West Africa account for:

- 60% of total grain production
- Half of daily calorie intake
- One-third of daily protein intake
- 50-60% of total food expenditures of population

Many urbanized areas of Africa have adopted more costly, imported cereals as their staple foods. By focusing on the coarse grains, millet and sorghum – which are the dominant and indigenous cereal food crops of West Africa – we ensure that our research directly addresses the poorest of the poor, those rural people who are not able to buy imported cereals. This also helps preserve food self-reliance, conserve national hard currency reserves (fewer imports), and maintain biodiversity and dietary diversity in Africa.

Food Legumes and the SAT

- Food grain legumes are among Africa's highest-value crops
- Preferentially cultivated by women on private plots to meet household needs
- Surplus is marketed, yielding household cash
- Cash income to women benefits child welfare

Legumes provide protein, income, and cropping system diversity to rural families. They also especially benefit women, who tend to be involved in their cultivation.

Can Agricultural Technology Alleviate Rural Poverty?

Farmer-managed on-farm trials:

- ***Burkina Faso***: Small doses of fertilizer + tied ridges increased net farm income by 30-50%
- ***Niger***: Phosphorous + variety + sowing increased net farm incomes by 40%

Available evidence from careful studies is conclusive: agricultural technology innovations CAN substantially increase rural SAT incomes.

If Agricultural Technology can Lift the Poor out of Poverty – Why Hasn't It?

- Insufficient inputs and markets
- Inappropriate policies
- Nascent institutions
- Civil unrest
- Some technology recommendations inappropriate
- Insufficient knowledge dissemination

The constraints to agricultural growth are partly technical, and partly because of institutional and policy shortcomings. Unlike the past, where the Centers may have focused almost totally on the technical constraints, ICRISAT's Africa Agenda will take a very holistic approach. We will be hiring more socioeconomists to make this happen.

Strategic Leverage Point: Raising Soil Fertility

- Raising soil fertility will increase returns to improved varieties, and even to landraces
- Returns on investment stimulate more investment, more returns, more investment…
- Sustainable soil management practices increase vegetative biomass, protecting the soil while enhancing soil fertility

We believe that the single most important constraint in African agriculture is low soil fertility. We know that the potential of improved varieties can only partially be expressed under the current, low fertility levels. And we believe that poor fertility contributes to soil erosion, because of less vegetative ground cover. So by overcoming the fertility constraint, we will increase incomes, investment in technology, and more sustainable soil management.

How to Increase the Adoption of Improved Soil Fertility Practices?

- Institution and policy research to improve input and output channels
- Farmer participation to create adoptable technologies

- More effective technology dissemination

Again, the way to overcome the constraint of low soil fertility is to address the socioeconomic dimensions as fully as the technical dimensions. The keys are farmer participation, and new institutions to ensure a dependable supply of modest amounts of fertilizer at the critical time and place.

P12: SAT futures

- Where should the SAT be headed?
- Reorient our research to target poverty reduction
- Opportunities to commercialize SAT agriculture

The last Project in our Portfolio, P12, should perhaps be the first. It is our strategic assessment of the future of the semi-arid tropics, and of our role in it. It will lead to a new Institute Strategic Plan next year.

P12 Outputs

- Strategic assessments of:
  - changing commodity trends
  - product market constraints
  - input supply and access constraints
  - investment patterns in crop-livestock systems
  - opportunities for poverty reduction

This Project will produce a set of strategic insights on the major trends and directions of SAT development. At the end of the day, it should help us identify the most promising intervention points that will influence the needs of the SAT over the next 20 years.

ICRISAT's Mission

Help developing countries in the SAT

- increase crop productivity and food security
- reduce poverty
- protect the environment

through partnership-based research with NARS, ARIs, NGOs, private sector

Our Mission is closely aligned with the humanitarian ideals of the CGIAR: to reduce poverty, hunger, and environmental damage in the semi-arid tropics. We carry out this mission through close partnerships with a wide array of complementary institutions.

Focus: Reduce Poverty & Food Insecurity

- Agricultural research-for-development as an intervention point
- The rural semi-arid tropics
- The poorest of the poor
- Five crops

Sorghum
Millet
Groundnut
Chickpea
Pigeonpea

While we carry out genetic improvement on five of the most important staple food crops of the poor of the dry tropics, we study many different crops in our farming systems research, since these are all important in the real lives of the rural poor.

ICRISAT Research Programs

Genetic resources
and enhancement

Major Thrusts

- Conserve biodiversity of important SAT food crops
- Apply "new science" methods – applied genomics - to unlock entirely new useful traits for crop improvement
- Investigate biology and improvement of disease/pest resistance, stress tolerance, quality
- Share with partners breeding materials in farmer-ready forms

We organize our research via three Programs. The Genetic Resources and Enhancement Program is our largest, and combines cutting-edge new science in the areas of genomics, with vital work in germplasm collection and conservation, and with the development of gene pools and new traits that our partners and farmers can put to use in the near term.

ICRISAT Research Programs

Natural resources management

Major Thrusts

- Practical, adoptable soil fertility improvement - if successful, huge productivity gains possible
- Watershed crop/soil/water management to intensify, diversify, and conserve the SAT's most valuable land asset
- Emphasize farmer-participatory and environment-friendly crop and pest management approaches
- Convene Systemwide Desert Margins Program

Our Natural Resource Management Program is focused on finding farmer-appropriate means for enhancing productivity while protecting the environment. Since our focus is on dry areas, the water resource is of special concern and attention. We also convene the Systemwide Desert Margins Program. The convening function is fully integrated with our MTP portfolio as one of our Center Projects, even though the work of this Program goes far beyond ICRISAT, involving many partners.

P11: Priority setting and impact

- Tool to guide future priorities
- Tool to persuade donors of our effectiveness
- Build NARS impact assessment capacity

P11 is the first of our two socioeconomic Projects. It's our eyes and ears: measuring the impact of our work, and using this knowledge to readjust our priorities.

P11 Outputs

- Methodology for priority-setting
- Impacts of technologies quantified
- Impact monitoring system in place
- Constraints to technology adoption identified
- NARS impact assessment skills enhanced

P11 approaches impact assessment from a partnership point of view, helping strengthen partners' skills through joint assessment teams on the ground. It helps both us and our partners sustain our research, by giving us the information we need to convince development investors of our successes, as well as to help us learn from our failures.

P10: Pod and stem borer control

- Pod borers of legumes cause huge income losses
- Biotech breakthroughs
- Natural enemies and other IPM techniques

P10 is our last project in the genetics area. It is focused on one of our most difficult and damaging constraints: pod borer insects on our legume crops, pigeonpea and chickpea. (Groundnut is not affected since its pods develop underground!) We see much potential for biotechnology solutions here.

P10 Outputs

- Screening methods and selection criteria
- Resistance genes found, mechanisms understood
- Interspecific derivatives with resistance
- Transgenic plants with Bt and protease inhibitor-based resistance
- IPM modules for sustainable crop protection

We continue to research these borer insects, especially *Helicoverpa*, a relative of the notorious cotton boll weevil, at both a basic level and in terms of resistance screening and biotechnology, and integrated pest management. We are still trying to fully understand the plant mechanisms which either encourage or discourage egg-laying and feeding on our crops. We are improving transformation and regeneration protocols and inserting promising genes into these plants. We'll be testing their performance in our biosafe glasshouse and if we obtain permission from the Indian government, we can then move on to field trials. The economic impact of a breakthrough in this area would be enormous, worth hundreds of millions of dollars worldwide once adopted.

ICRISAT Research Programs

Socioeconomics and policy

Major Thrusts

- Forward-looking, proactive approach: SAT future assessment for research prioritization
- Economic growth through enhanced input & market institutions and higher-value products, and crop/enterprise diversification
- Assess impact and feed into priority setting and policy research
- Articulate policy options to improve livelihood of SAT poor

We will be increasing our staffing and investment in our Socioeconomics and Policy Program during the Plan period. We see progress in policies and institutions, and in research priority-setting, as key to overcoming some of the bottlenecks to impact which we have been facing, especially in Africa.

MTP Process

- Rolling annual process
- Partner consultations
- Staff consultations
- Africa Agenda – new dimension
- Projects revised, reduced, streamlined

We have made efforts to consult our wide array of partners in formulating this MTP. We have included a special chapter on our Africa Agenda. The Africa Agenda is an integrated summary of the rationale, strategy and workplan for our effort on that continent. While we are highlighting them separately in the MTP to emphasize the coherence of our Africa-wide approach, the activities of the Africa Agenda are fully integrated within our twelve global Center Project profiles in this MTP.

Partner Consultations

- Operational project workshops
- Stakeholder meetings
- Network meetings
- Letter to SAT NARS leaders

Since the 'rolling MTP' process is now annual, we've worked our partner consultations into our normal, ongoing stream of partnership events. We think that this continuous approach to seeking partner views allows a better result than formalized, large conferences which are often too short for a full consultation.

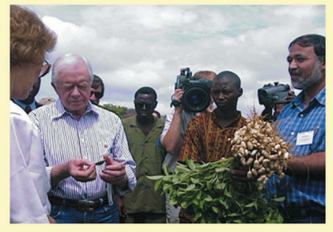
MTP Project Portfolio

Twelve Center Projects

This year we consolidated our projects from fourteen to twelve. We think we've achieved a clearer set of projects with this consolidation. I have to thank our three new Program Directors for having worked very hard over the past twelve months to accomplish this. I will briefly describe the purpose and the main expected outputs for each Project.

P9: Major constraints of groundnut: aflatoxin, drought, virus, foliar diseases

- Aflatoxin causes cancer, blocks exports
- Diseases & drought cause major losses
- New detection tools
- Resistance screening methods
- Incorporate resistance into varieties
- Increase public awareness



P9 is focused on a single crop – groundnut – and a number of difficult but important problems which we decided to highlight separately to increase focus and monitoring of progress. Aflatoxin is of major global concern, and hurts SAT incomes by blocking export potential.

P9 Outputs

- Affordable diagnostic tools for aflatoxin
- Enhanced resistance to *A. flavus* fungus
- Efficient drought resistance breeding methodology
- Integrated management packages for diseases
- NARS skills enhanced for groundnut disease control

The outputs for this project include diagnostic tools, breeding methods, resistance genes, and IPM packages, along with training of our national partners for all these areas. We are making exciting progress in improving diagnostic tools for aflatoxin.

P8: Improving seed supply for research impact

- Improved seed of SAT crops hard to find
- Non-traditional seed producers: millers, processors, entrepreneurs
- Improve emergency seed aid programs
- Assess biodiversity risks/benefits of improved seed

P8 is our response to a special problem of the crops of the poorest of the poor: they are relatively neglected by the conventional seed sector because their market volume is less than the more popular crops. We are working with a wide range of institutions, many not traditionally involved with seeds, to overcome this problem. For example, we are working with food processors and village-scale retailers such as this lady, because their sales success is dependent on a reliable supply of a quality product.

P8 Outputs

- Guidelines for seed systems for NARS Directors
- Case studies in seed supply – lessons learned
- Policy/operations recommendations for emergency seed relief programs
- Strategies for sustaining community seed schemes
- Policy options for sustainable national seed systems

In terms of outputs, this Project also provides assistance to the international relief aid community by helping understand how we can better execute emergency seed relief programs. Once engaged, we hope this community will learn with us how we might move beyond emergency, towards sustainable seed systems. We also address policy issues, such as national seed policies which may sometimes be unintentionally discouraging to organizations trying new ways of producing and disseminating seed.

P1: Raising soil fertility to help SAT farmers grow their way out of poverty

- Low soil fertility blocks impact of improved crop varieties
- Poor crops don't protect soils
- Downward spiral impoverishes people

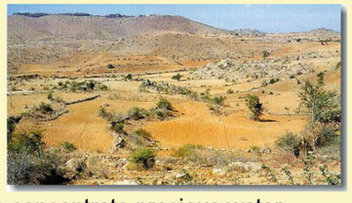
Our first Project, P1, focuses on the basic constraint of low soil fertility, especially in Africa. This is the main blockage to improving productivity. And without fertile soils, the land can't achieve a good ground cover to protect it from erosion. We've got to find a way to reverse the downward spiral of lower fertility, which leads to greater erosion, leading to even lower fertility… and so on.

P1 Outputs

- Smallholder-appropriate soil fertility & water retention techniques
- Indicators of soil degradation
- Participatory methodologies, GIS, simulation models

As outputs of this first project, we take a very farmer-participatory approach to find out why farmers are unable or reluctant to enhance soil fertility. We adjust our improved technologies to fit the means and priorities of farmers. New tools such as modeling and GIS are helping us untangle the complex of issues involved.

P2: Developing community-scale watersheds to improve rural livelihoods



- Watersheds concentrate precious water, soil, nutrients
- Highest-risk, highest-reward intervention point
- Future wealth generator if managed sustainably

Our second Project, P2, is focused on water and watersheds. We recognize that these are the critical land forms which concentrate water and soil, the two major limiting resources of the SAT. If they are well-managed, they can create prosperity for local communities. If mismanaged, they can create a wasteland. These are high-payoff intervention points for sustainable development of the SAT. Again, farmer-appropriate solutions are the key to success.

P2 Outputs

- Water harvesting and management options
- Institution/policy/community mechanisms for shared management of water
- Technology, policy options for watershed protection
- GIS tools for watershed development, management
- Watershed development models for replication

This project is producing management options and institutional and community models, along with technologies for the more sustainable and productive management of watersheds.

P7: Genetic diversification and enhancement to increase productivity

- Gene pools for major production systems
- Hybrids for higher productivity
- Novel traits for biotic and abiotic stresses
- Network and seed programs for impact

P7 is our bread-and-butter gene pool development project. It provides breeding lines with new traits that NARS can use, and helps them use them to breed finished varieties. It supports networks and seed production efforts as well. It is our link to adoption and impact.

P7 Outputs

- Resistance sources, screening methodologies
- Genetically diverse base populations
- Cytoplasmic male sterility systems diversified
- Information resource base for breeding enhanced, accessible
- NARS capacity building, network support

The outputs of this project are the essential core outputs of any holistic breeding program. While we've emphasized the strategic breeding end of the spectrum in response to our EPMR and funding constraints, we've been careful to ensure that in this project, our outputs are readily usable by our NARS partners and we work with them to ensure that this is a seamless transition to impact.

P6: Applied genomics for SAT crop improvement

Opens new vistas for

- Biodiversity conservation
- Disease diagnostics
- Plant breeding

We are re-invigorating our thrust on using the new tools of biotechnology this year through Project P6. We just hired a new head for our Applied Genomics Laboratory, Dr. Jonathan Crouch. We have built secure containment facilities for greenhouse testing of transformed plants, and are fully compliant with all the biosafety regulations and standards.

P6 Outputs

- Marker & bioinformatic technologies adapted and/or developed
- Linkage maps constructed
- Useful genes and QTL mapped
- Marker assisted selection tested, assessed
- Pathogen variability characterized

Our focus for the new thrust will be on on gene mapping and marker-aided selection. This will improve both the efficiency and effectiveness of plant breeding, and also our ability to assess pathogen race diversity and race changes.

P3: Farmer-Participatory IPM

- Food legumes are especially susceptible to insects
- Head bugs, miners, borers plague ICRISAT cereals
- Reduce human health hazards from pesticides

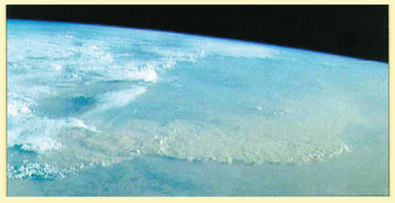
Our third Project, P3, addresses integrated pest management as a biotic component of sustainable production systems. We want to help farmers reduce expenditures on pesticides and protect their health, without sacrificing crop productivity.

P3 Outputs

- Best-bet IPM options for on-farm testing
- Policy, investment, and institutional options to improve adoption
- Catalyze extension and adoption in target areas, through relevant partners

Much of our work in IPM is on-farm, and with NGOs. We recognize that our outputs for IPM have to include effective models for skills-sharing, because these are very knowledge-intensive technologies.

P4: Reducing poverty and protecting the environment in the desert margins



- Major global environmental concern
- Diversify through new crop/livestock/tree options
- Policies to promote sustainable land use

As I mentioned earlier, we convene the Systemwide Desert Margins Program. It seeks solutions to the relentless march of the desert, often made worse through inappropriate tillage practices and other agricultural effects. In this NASA satellite photo you can see the incredible dust storms of the harmattan rolling south from the Sahara Desert across West Africa. You can imagine the amount of fertile topsoil displaced through this annual cycle.

The Desert Margins Program is highly partnership-based. It brings the experience of UNEP and UNDP in the implementation of the UN Plan of Action to Combat Desertification together with the scientific skills and expertise of nine NARS and NGOs, four sub-regional organizations (CILSS/INSAH for western Africa, SADC/SACCAR for southern Africa, and IGADD and ASARECA for eastern Africa), four advanced research organizations (CIRAD, IH, ITE, and ORSTOM), and eight international Centers (ICARDA, ICRAF, ICRISAT, IFPRI, ILRI, IPGRI, IBSRAM and IFDC).

P4 Outputs

- Strategies to combat desertification
- Decision support systems for response farming
- Spatial models/methods for scaling up to extend impact
- New crop/livestock/tree options to diversify and increase incomes

This broad and ambitious Project is helping the world find ways to arrest desertification, using both modern tools such as GIS and modelling, and by rediscovering and sharing indigenous knowledge, technologies, and skills. It has a strong emphasis on biodiversity conservation and cropping system diversification as well.

P5: Saving and using SAT biodiversity

- FAO in-trust responsibility
- Learn from farmers: stewards of crop biodiversity
- Enhance NARs capabilities to manage national biodiversity

Now shifting to our germplasm and breeding projects, we begin with P5, which carries out our FAO in-trust responsibility for germplasm conservation, along with its characterization and utilization. ICRISAT holds the CGIAR's largest gene bank collection, with 113,000 accessions. This irreplaceable resource is the core underpinning for our breeding capability as well.

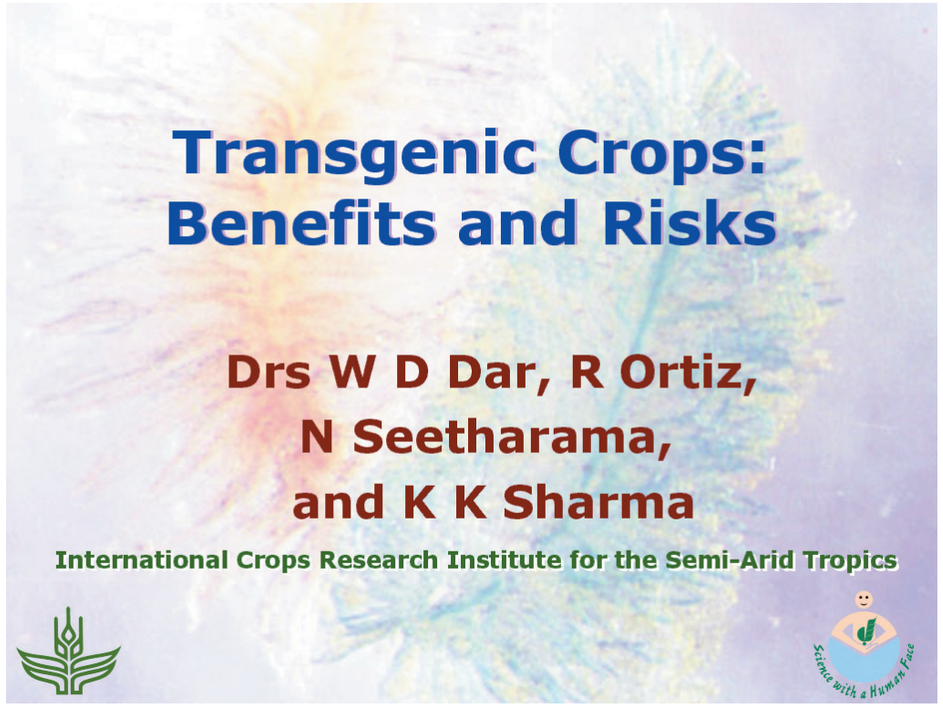
P5 Outputs

- ICRISAT in-trust gene bank safely conserved
- Accessions characterized, utilized
- Safe and expedient germplasm exchange
- Farmer's diversity management practices understood
- Value of genetic resources assessed

We take our in-trust responsibility seriously and are aiming to achieve international standards for all our gene bank operations through this project. We are also putting heavy emphasis on understanding how farmers manage and value genetic diversity, because the most valuable diversity is that which continues to be useful and to evolve through human interaction.

Transgenic Crops: Benefits and Risks

– presented on 19 July 2000



Finally, I will sum up our MTP by addressing the issue of resourcing. ICRISAT has been under greater pressure than many Centers due to declining funding. We believe that our mission is a high priority in the eyes of the world, but our ability to deliver on these challenges needs to be communicated effectively and convincingly. We also must work even harder to ensure that equal partnerships are involved, because our partners can be our best advocates to the development investor community. We also have to continue to strive to increase our operating efficiency and care of resources.

Well, that's it. Thank you all very much for letting me tell you about our renewal of ICRISAT, through our people-first approach which we call 'Science with a Human Face'.

Win-Win Solutions to the Productivity/ Environment Dilemma for the Semi-Arid Tropics of West Africa

– presented on 18 July 2000

W. D. Dar, B. I . Shapiro, A. Bationo, and M. D. Winslow

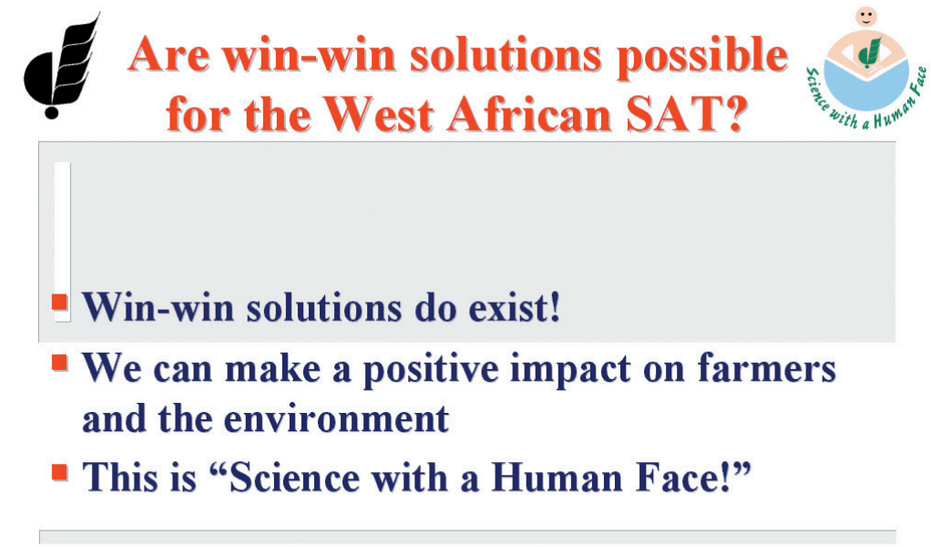
Ladies and Gentlemen,

In many people's minds, there is a dilemma between research to protect the environment, and research to increase agricultural productivity. They view these as two opposing goals, in conflict with one another.

The current low-input agriculture of the dry areas of West Africa will not generate the 6% annual growth rate estimated as necessary by the Special Program for African Agricultural Research (SPAAR), the Forum for Agricultural Research in Africa (FARA) and the CGIAR, in order to feed its burgeoning population in the coming decade. To meet this target, intensification of crop production will be required, both in terms of improved varieties and better land and water management.

But there is widespread concern that the intensification of agriculture in this marginal environment may risk damage to the soil and watersheds through erosion, water pollution, and losses of biodiversity. This degradation also effects the peoples living in these areas. Because they are mostly involved in agriculture, this process throws them even deeper into poverty.

In spite of these harsh realities, however a major thesis of my presentation today will be that the goals of increasing productivity and protecting the environment are not only highly compatible goals – but that they are also goals that are most effectively researched in an integrated manner.



We at ICRISAT do not accept the gloom and doom predictions about the WA SAT. Win-win solutions exist and can be realized through science-based science that builds on farmer knowledge. This is the goal of science with a human face.

Interventions to increase seed & fertilizer availability and use

- Removal of regulatory barriers to private sector seed multiplication and inorganic fertilizer importation
- Promotion of efficient, timely distribution
- Targeted fertilizer subsidies to farmers through demonstrations (Global 2000)
- Effective credit, perhaps to traders instead of farmers

Policy and investments to improve the functioning of input markets are especially critical.

Linking research to technology transfer efforts to increase impact

- Research and development agencies, including NARS and NGOs, need to become better integrated in their work to ensure greater impact
- Greater interaction is needed with the development agencies, including multilateral organizations such as FAO and UNDP
- Greater interaction with farmers, women, NGOs, and the Private Sector
- Full involvement of all partners and stakeholders in research priority-setting

Realizing this potential raises critical questions regarding technology research and exchange strategies. Better participatory research methods and approaches are needed, as well as increasing the linkages and interactions between all the stakeholders in this effort.

The Intensification Dilemma

- Dilemma: intensification can undermine future production gains and livelihoods
- Can win-win solutions be found?

Can we intensify production without undermining the very resource base that underpins it for the longer term?

We believe the answer is Yes – if it is done through a careful process of analysis, testing, and validation on-farm, with participation of farmers and others in the agricultural community.

Our experiences with our national research partners have shown that better soil and water management combined with improved crops can be a win-win strategy.

The Win-Win Solution

- A combination of local and external inputs – organic and inorganic fertilizer
- Inputs of local organic matter maintain soil structure and health
- Inputs of inorganic fertilizer raise fertility
- Water retention enhances response to fertilizer and improved crop varieties

How does this work? Most NRM technologies currently promoted for this agroecological zone are basically low-input strategies of two types: firstly, locally-sourced fertility measures such as manure, crop residues, composting, biological nitrogen fixation, rock phosphate, etc., and secondly, water retention techniques – bunds, dikes, ridges, tied ridges, *zais*, etc.

Our field results indicate that these low external input technologies complement, but cannot replace the additional need for inorganic fertilizer and improved varieties, given the significant agricultural growth target we are aiming for. We find that the optimum solution is to combine the locally-sourced techniques with modest amounts of fertilizer and improved varieties. These produce a synergistic, positive interaction while replacing soil organic matter and providing balanced soil fertility. Small amounts of fertilizer are more affordable and therefore more appropriate for cash-strapped smallholder farmers.

NRM Research and Development Priorities: Socioeconomic Issues

- Foster a fuller participation of all stakeholders
- Gather indigenous knowledge, and share it
- Understand farmers'decision-making processes and motivations
- Jointly test and evolve new institutional arrangements
- Learning how to promote better functioning markets

Solving socioeconomic constraints to sustainable intensification requires a people-first approach to research. Participatory methods must be applied, and diverse organizations must be fully involved and committed to solutions – or else they will never be achieved.

What kind of policy support is required in the risky environment of the SAT

- Support against crop price collapse in good years
- Processing and product development to maintain and increase cereal demand
- Market/infrastructure development to ensure inputs (seed, fertilizer are available
- Import/investment policy to support seed & fertilizer availability and use

Solutions at the institutional and organizational levels must be also be found to provide policies conducive to adoption technologies that will lead to intensification and integration into markets.

NRM Research and Development Priorities: Biophysical Issues

- Watersheds: a strategic leverage point
- Simulation models to identify synergies and tradeoffs
- Develop appropriate water retention technologies
- Use climatic information for adaptive decision making

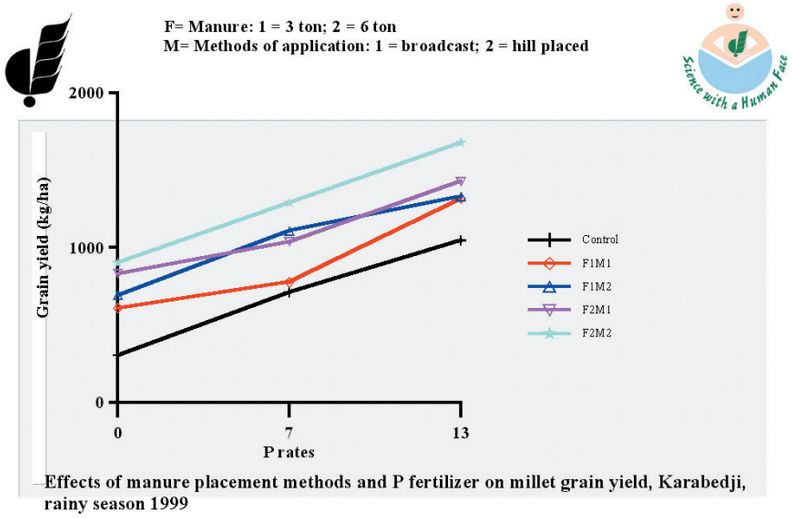
Given these development dynamics, where should we place our research priorities for the objective of sustainable intensification?

Watershed research appears to be especially strategic, because these are the land forms in which water is least limiting and soils tend to be more fertile, so that intensification can reach its potential. Where there is reward, though also lies risk: the importance of sustainability as a technology criterion for watersheds is very important, because these sloping soils are rapidly destroyed by inappropriate technology.

Simulation modeling is a key tool in helping us understand these complex systems.

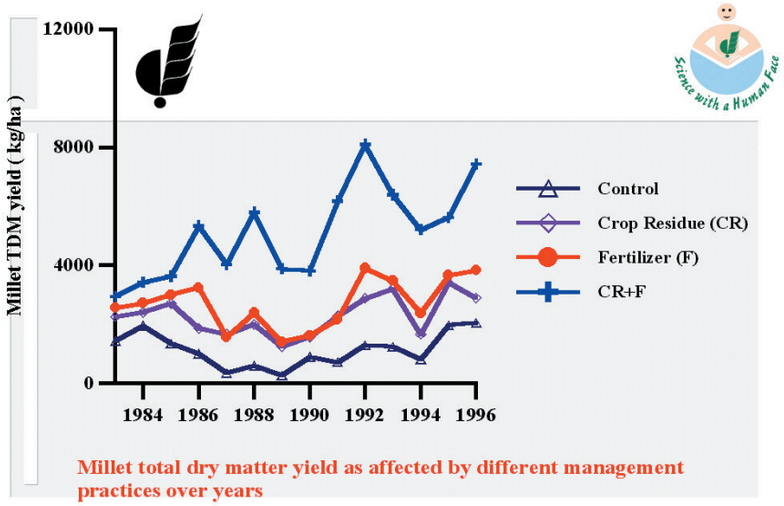
Water retention technologies need to be tailored to particular conditions of soil type, climate, and the availability of labor and equipment.

In the dry areas, the ability to predict climatic events such as rainfall would be an extremely powerful tool for farmers. For example, we have found that we can predict with a high accuracy the length of the growing season in the sub-Sahelian zone based on the day of first rainfall, because the termination of the rainy season is much more predictable than its onset there.



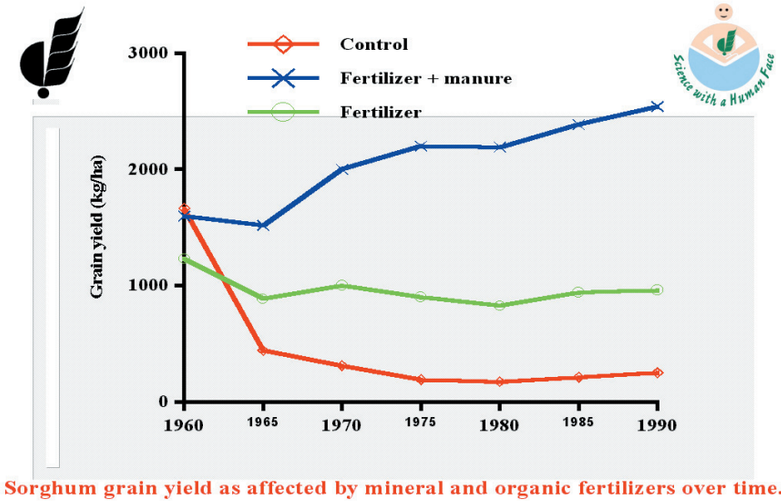
Effects of manure placement methods and P fertilizer on millet grain yield, Karabedji, rainy season 1999

Our work in the West African SAT shows that even small amounts of P fertilizer can add significantly to yields when combined with moderate amounts of manure in millet systems. Furthermore, hill placement of manure and P fertilizer is more effective than broadcasting.



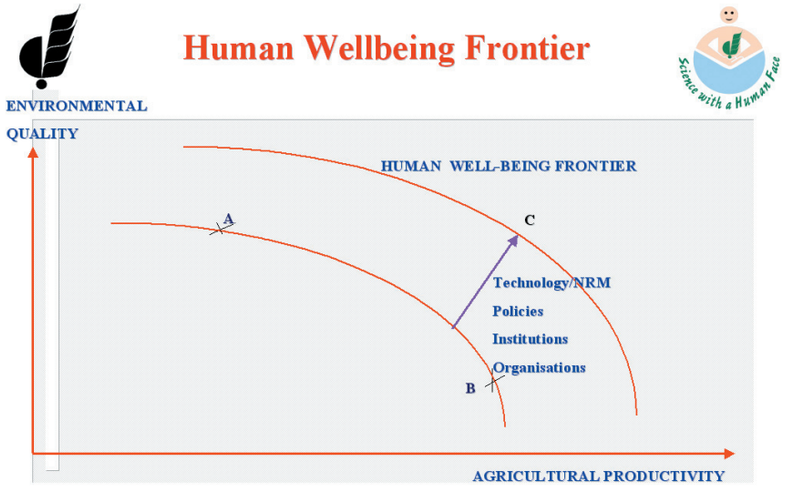
Millet total dry matter yield as affected by different management practices over years

Furthermore, these results hold up over time. The data presented here from an experiment carried out by ICRISAT over 12 years in the Sahelo-Sudanian zone clearly show the sustainable superiority of combining local and external sources of soil nutrients, despite yearly fluctuations in rainfall. There results have also been found by others working in the region such as Ortsom.

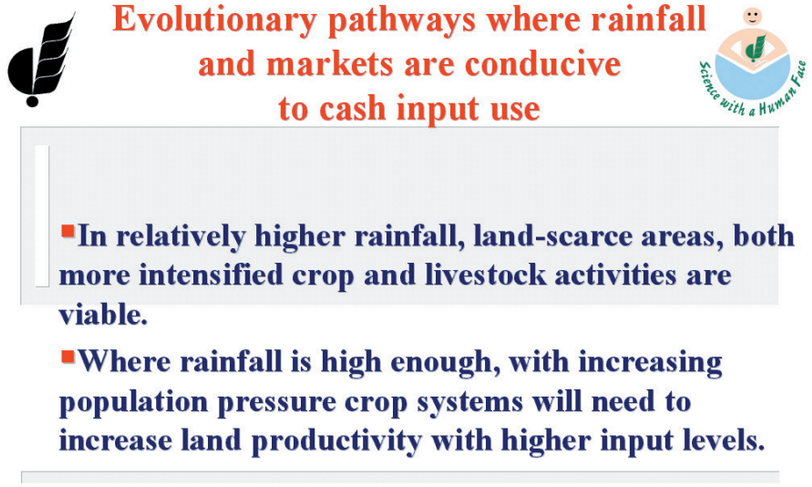


Sorghum grain yield as affected by mineral and organic fertilizers over time.

Some people have argued that long term fertilizer use is not an approach that will result in long term increases in cereal yields in the agroecological conditions prevalent in the West African SAT. These results of a long term on-station experiment carried out by Orstom show that while fertilizer alone may not have a positive effect on sorghum yields, the combination of mineral fertilizer and organic matter in the form of manure has the potential to continue to impact positively on yields over time.



Such a win-win situation can be represented graphically by this Human Well-Being Frontier. While we may not be able to eliminate the tradeoffs between intensification and sustainability, this combined local/external input strategy, if supported through the necessary policies and institutions, makes more efficient use of natural resources across the range of intensities, so that we can shift that relationship towards a higher state of well-being, as shown by line 'C'.



The bottom line is that in relatively higher rainfall, land-scarce areas, both more intensified crop and livestock activities are viable. Where rainfall is high enough, with increasing population pressure crop systems will need to increase land productivity with higher input levels.

While biologically and economically efficient, improved technologies for sustainable intensification have found only limited adoption because of a range of difficult socioeconomic constraints. If inputs are not available and if markets are easily glutted because of inability to transport the goods to other deficit areas, farmers find no rewards in intensifying production.

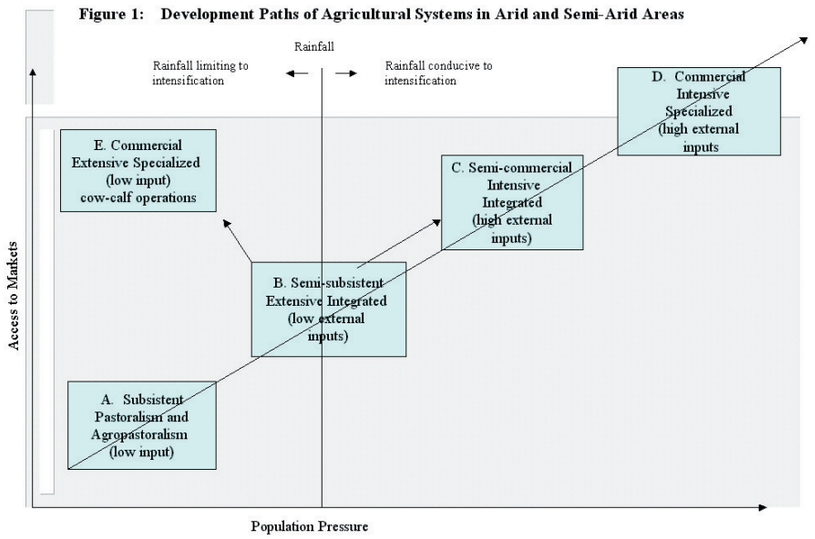


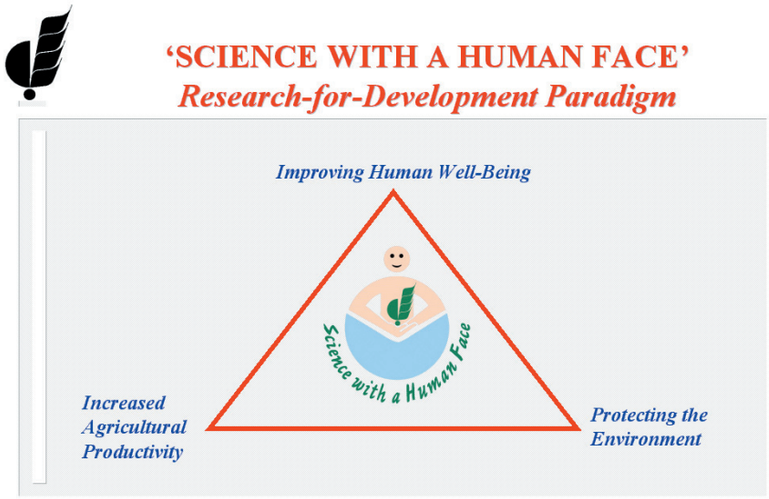
Figure 1: Development Paths of Agricultural Systems in Arid and Semi-Arid Areas

To address these questions and bring some of these ideas together in a conceptual model, we developed this graphic to represent our understanding based on extensive empirical evidence from the field and from whole-farm modeling of system dynamics.

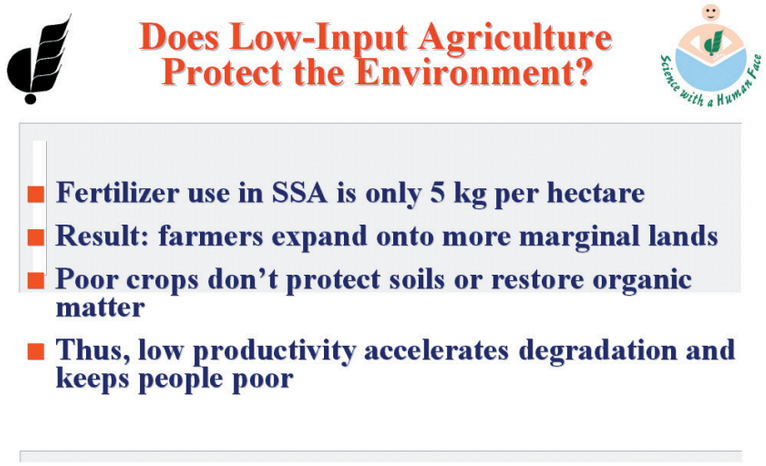
This model suggests that two of the most important factors driving the development process are access to markets (on the vertical axis) and population pressure (on the horizontal axis). The system response to these factors is quite different for areas with insufficent rainfall, compared to those with adequate rainfall or irrigation, so we have superimposed that factor onto the graph as well.

As farmers gain access to markets and as population pressures make it more difficult to gain additional free land, they become motivated to intensify production on their existing land. This stimulates the uptake of new technology, and this is where research-for-development has a critical role to play in ensuring that those technologies are both effective, and sustainable.

In low-rainfall areas (or where irrigation is unavailable), quite a different path will be taken. Farmers will not intensify because the returns are not there. These lands will generally remain under subsistence pastoralism, that is, nomadic grazing of livestock, or if land use policies are conducive, the system will evolve towards commercial, large-landholder grazing operations.



We describe our effort to extend the Human Well-Being Frontier as 'Science with a Human Face', combining increased agricultural productivity with protecting the environment to improve human well-being. This is not science just for the sake of science, but science to make a difference in the lives of the resource-poor smallholder farmers of the SAT



It is often assumed that low-input agriculture is safer for the environment. But this is not the case when considered in its full socioeconomic context. To feed their families, farmers faced with low-input situations find they need to expand their cultivated lands onto the more marginal areas that are still available. This leads to poor crops which do not cover the soil adequately, leading to soil erosion and further expansion the next season. This creates a vicious downward spiral of poverty and food insecurity.

Does Low-Input Agriculture Protect the Environment?

- Fertilizer use in SSA is only 5 kg per hectare
- Result: farmers expand onto more marginal lands
- Poor crops don't protect soils or restore organic matter
- Thus, low productivity accelerates degradation and keeps people poor

Can the poor be expected to protect the environment? Many studies have found that poor smallholder farmers only become concerned about environmental degradation when it becomes visible and substantial. Until then, their major concern is getting enough food for their families. Only when their poverty is alleviated, can they afford the breathing room to consider longer-term investments in rebuilding soil fertility for sustained production.

Why should Farmers Adopt Improved Soil-Water-Crop Technologies?

Potential for New Sorghum and Millet Cultivar Diffusion With and Without Input Use in Zimbabwe

Cultivar[a]	Without Input Use IRR	With Input Use IRR	Yield Increase
SV 2 (S)	18%	39%	82%
PMV 2 (M)	31%	58%	80%

[a] Sorghum and millet are respectively, identified by the letters S and M in parentheses

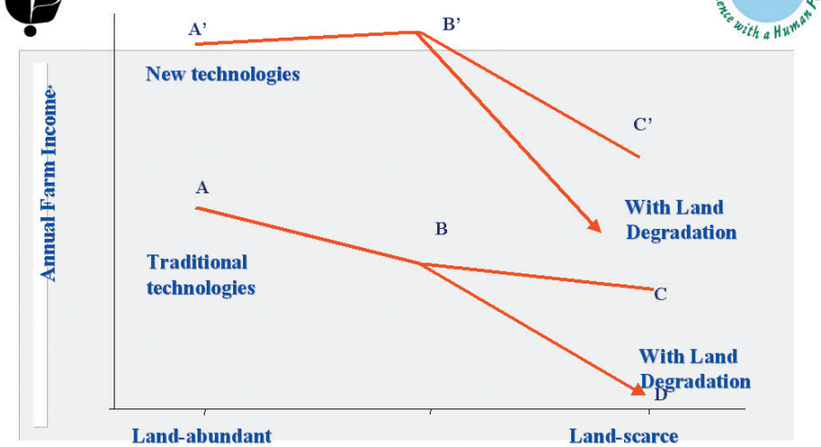
Source: adapted from Ahmed, Sanders and Nell, 1998

Despite the agricultural and environmental advantages, farmers must have a reason or motivation to adopt this technology package. If they do not see the value to themselves and their families, they will not adopt.

However, studies in the semi-arid tropics of southern Africa have found that these technologies significantly enhance returns on farmers' investment – IF the necessary inputs and knowledge are available to them. This motivates farmers to adopt new technology, and to further invest in system improvements in the next cropping cycle.

Better soil fertility management can make the returns to new varieties much higher, increasing their adoption potential.

Need to bring about technological change before land degradation occurs



Source: adapted from Sanders, Shapiro and Ramaswamy, 1996, p.88

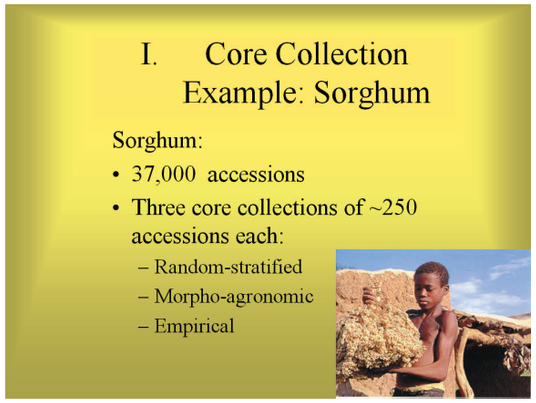
Furthermore, our data indicate that this state of higher yet sustainable productivity can however be diminished if there is little land available, because farmers then tend to fallow the land less frequently; and if the land was in a degraded state to begin with, this reduces the response to inputs. Nevertheless, many farmers have no alternative. Even in these less optimal situations, our data show that the combination of inputs increases annual farm incomes to a significant degree.

Limits to Intensification

- Is intensification possible everywhere?
- What viable systems exist for areas where intensification is not sustainable?

Where population pressure is high in the semiarid zone, it is leading to land degradation. Ultimately, there will be a return to extensive livestock production if intensification does not take place. With increasing population pressure, inadequate water availability and low use of inputs due to a poor economic environment, crop fertilization will not be profitable. Hence, yields and incomes will decline.

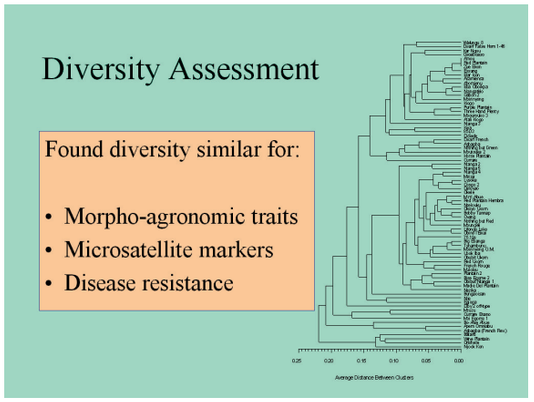
Extensive, low-input systems work where both rainfall and population pressure are low. Here crop intensification is not appropriate and is unlikely to occur. Improved livestock activities that can substantially increase farmer incomes will ultimately require consolidation of landholdings to gain efficiencies of scale.



To illustrate the new approach, I'll start with the case of sorghum.

The first step is to create a core collection. Ideally, this core subset will represent the entire useful diversity of the original base collection, but in a smaller and therefore more practical size.

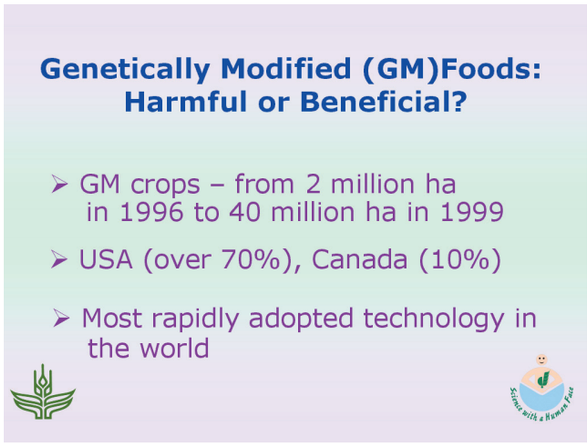
A crucial question in defining core collections is how to measure 'useful diversity.' If we get this wrong, we could miss some important genes. Through a very productive partnership with CIRAD, Dr. Cecile Grenier joined us to study this. She used three different methods to create core collections: a) selecting randomly across the base collection; b) selection based on visible diversity; and c) selection based on our empirical understanding of race and ecotype diversity.



Cecile and our ICRISAT team tested the three core collections by measuring their diversity in three ways: diversity for microsatellite SSR markers; diversity for morphological traits; and diversity for resistance to five major diseases of sorghum.

They found that despite these different methods of creating the core collections, they all covered the same broad range of diversity as in the original base collection.

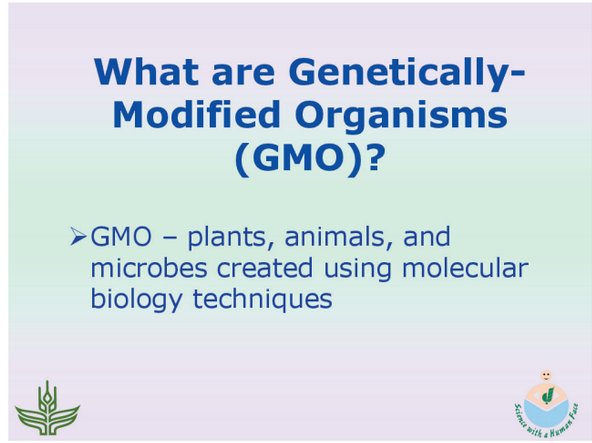
This finding is encouraging, because it suggests that core collections are indeed an effective way to create a 'snapshot' of diversity, and that we may not need to create different core collections for different traits.



Genetically modified or GM foods have made a big splash in the media lately. During last year, such bioengineered crops were grown on nearly 40 million ha (100 million acres) in 12 countries, up from less than 2 million ha when they were first introduced in 1996. This makes GM crops the most rapidly adopted technology (25-fold) in the history of agriculture.

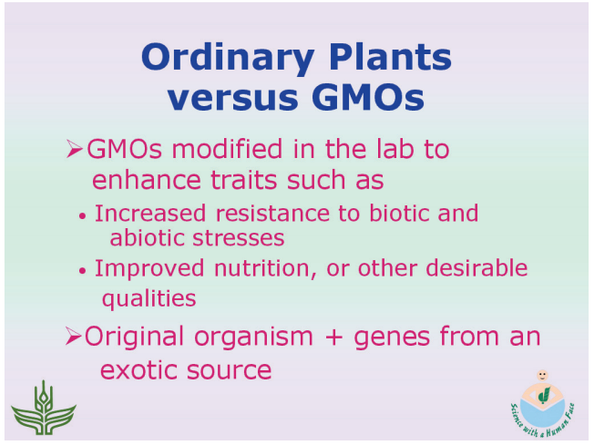
Over 70% of GM crops are grown in USA and 10% in Canada, and the rest of the area is in Argentina (15%), Australia (1%) and South Africa.

No good statistics from China yet, but Chinese are obviously very keen to adopt this technology.



To ensure that all of us are talking about the same thing, let us ask what genetically-modified organisms (GMO) are: The term GMO refers to plants, animals or microbes created for human benefit by genetic engineering using recombinant DNA technology. GMOs are also known as LMO (living modified organisms).

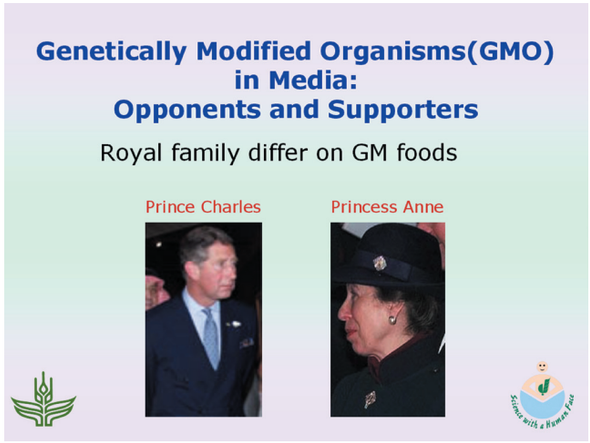
GM crops are essentially crops for human or animal consumption either used as basic food or to supplement essential nutrients (vitamins) or as therapeutics (either as plant medicines or as vaccines).



GMOs have been modified in the laboratory to add one or more desirable traits such as increased resistance to herbicides, insects and diseases, and drought and salinity, or to increase nutritional value or to change the developmental pattern of a crop to increase its adaptation to new environments .

The process used to add these novel genes is unconventional, and such genes can be tailored to suit the recipient host. However, gene transfer across species barriers also occurs in nature, albeit at low frequency. For example, the plant tumors are caused by a well-known bacterium called *Agrobacterium*.

In spite of the well-known advantages of GMOs, there is a raging controversy over the relative risks and benefits. The media reports are full of such debates that are taking place within families and in the public. Prominent personalities oppose or endorse this technology

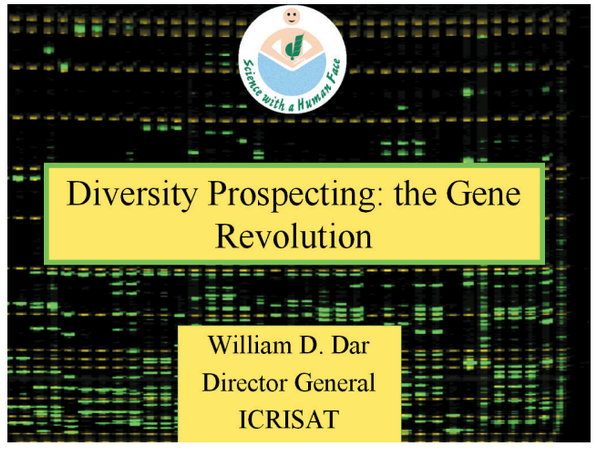


For example, in the British Royal Family, Prince Charles opposes GMOs, while Princess Anne endorses them !

Some religious organizations and some trade unions are also strong opponents.

Diversity Prospecting: the Gene Revolution

Presented at ICW, Washington
October 2000



Mr. Chairman, Ladies and Gentlemen,

It is my pleasure today to outline ICRISAT's exploration of the new frontiers of biotechnology and bioinformatics. In the new millennium, we are prospecting for genes to better utilize the rich resources of our gene banks and breeding pools.

Putting Gene Banks to Work

Traditional approach	*New approach*
• Mass collection	• Core collection
• Mass screening	• Targeted gene mining
• Mass crossing & selection	• Markers to move genes

Before these new tools came on the scene, the conservation and utilization of genetic resources required a massive approach at all stages. We had to use massive numbers to find the useful nuggets of gold. Of course this was costly and time consuming, and that limited our progress. In the new approach, we are learning how to be much more targeted at all stages: collection, gene discovery, and moving the genes into good agronomic backgrounds.

Food for the Poor: ICRISAT's Approach (Continued)

- Access to enabling technologies
- Use new genes by:
  - conventional, molecular and transgenic breeding

- Helping national programs to access the enabling technologies through our role as "bridge-broker-catalyst"
- Collecting, collating, and sharing both molecular and phenotyping information for trait discovery,
- Complementing our strength in participatory research in conventional crop improvement with modern molecular and transgenic breeding.

ICRISAT's New Agenda

- Aim: Use science to fight hunger and poverty
- Approach: participatory research
- Strategy: indigenous knowledge + conventional research + cutting-edge technology

Our new agenda at ICRISAT is science with a human face. We will use science, including transgenic research, as a weapon to fight hunger, malnutrition, and poverty. For this we will follow a participatory approach, integrating conventional and cutting-edge technologies, with due respect to indigenous knowledge of the people.

We shall thus come closer to our common and shared dream of a prosperous, sustainable, and food-secure world in the semi-arid tropics. Thank you!

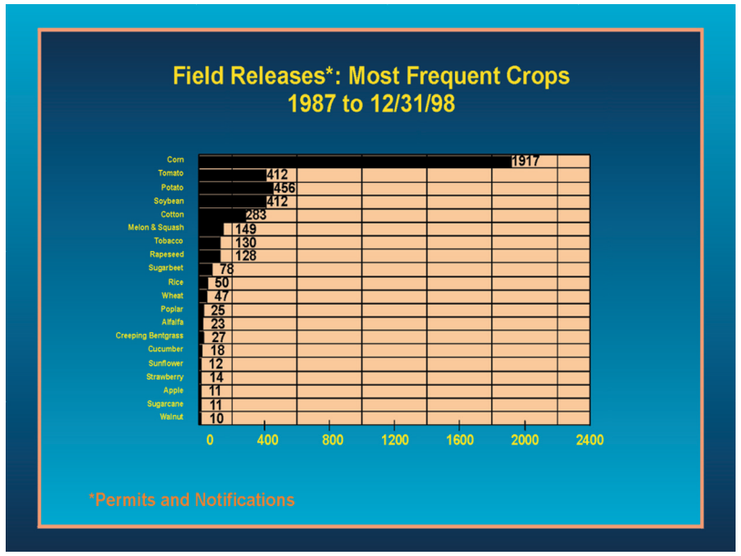
GMO in Media: Opponents and Supporters (Continued)

Supporters include many prominent scientists and statesmen

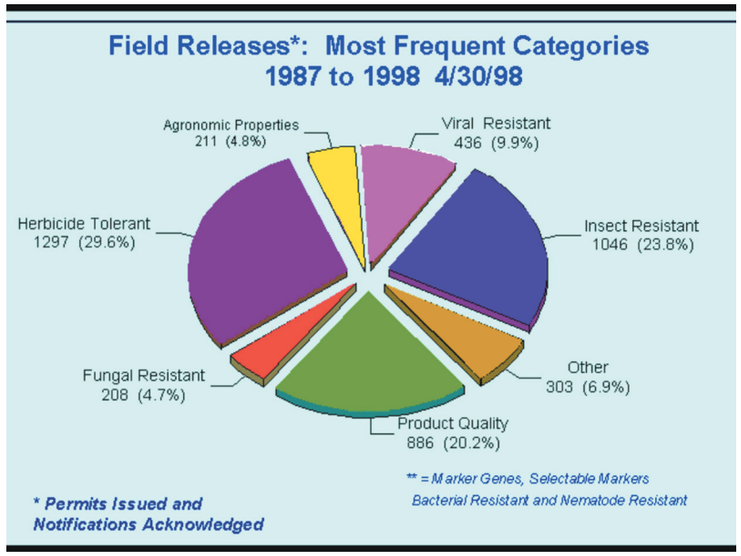
Nobel Laureate Borlaug

President Carter

However, many prominent personalities are equally vocal in supporting the development of GM crops, such as the world-famous agricultural scientist and Nobel-Laureate Norman Borlaug and USA President Jimmy Carter.



Over 40 plant varieties are already approved in the USA. Transgenic maize, soybean, and potato are the most common GM food crops. Cotton is also gaining popularity, so are horticultural crops like tomato and cantalope. Not all these products are available in supermarkets yet, but their number is gradually increasing.

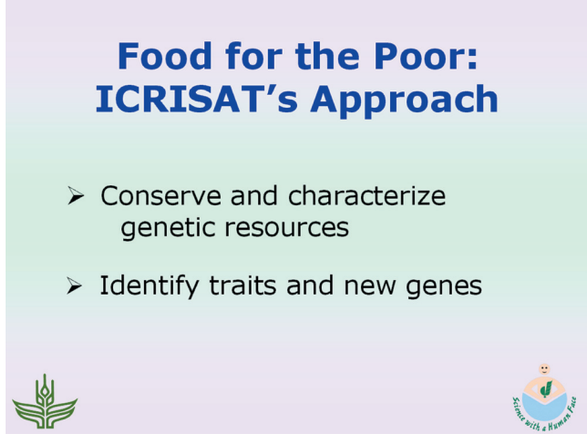


The need to reduce use of pesticides by using GM crops is of universal appeal worldwide. But it is also important to consider the use of transgenic crops in developing countries. Developing countries need to emphasize increased yield and nutrition.

Generation of GM products	Product type	Examples
First 1980s onwards	Input traits	Insect resistance (Bt.) Herbicide tolerance
Second 1995 onwards	Output traits	Vit. A enriched rice Oil quality, keeping quality
Third: 2000 onwards	Modified plant functions	Environmental amelioration Developmental control
Fourth: 2005 onwards?	Novel plants – post-genomic era	Drought tolerant crops C4 efficiency in C3 plants N fixation by cereals

Most of the initial controversy regarding GM crops arose because the traits were targeted for the developed country market like herbicide resistance, and there was not much involvement of the public. However, the newer waves of GM crops are more likely to be useful to developing countries by targeting their needs better. Ultimately, all will benefit as more progress is made to deal with complex traits like drought tolerance, photosynthetic efficiency, and nitrogen fixation by non-legumes are incorporated into the major crops.

It is important to test transgenics under totally safe conditions for which we have recently commissioned a transgenic greenhouse. ICRISAT follows all the guidelines of the Government of India in this regard. Once we prove that all transgenics with which we are dealing are safe, we will be very keen to work with scientists of the programs to test them under field conditions so that farmers can receive benefits as quickly as possible.



Summing up, let me make a few points about our approach at ICRISAT:

We believe that the genetic engineering and deployment of GM crops is an inevitable and welcome wave of the future.

To serve better the farmers of the semi-arid tropics, we can use this promising technology by:

- Conserving and characterizing genetic resources to produce future GM crops with novel characteristics,
- Identifying traits and novel genes based on comparative and functional genomics for deployment in important tropical crops.

GMO Issue: Summary (Continued)

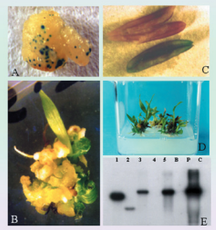
- Challenges for governments and others
  - Public awareness and education
  - Safety testing
  - Regulations including food labeling, and
  - International policy and trade
- Base decisions on validated information

One of the major challenges lying before governments is the need to educate constantly the public on both the benefits and the risks of GMOs, based on correct scientifically validated information.

To get benefit from GM crops, governments have to facilitate safety testing, develop appropriate regulations for safe use, and finally examine the implications of national policies on foreign trade and relations.

Transgenic Research at ICRISAT

- Transgenics at hand: virus resistant groundnut plants ready for testing
- Progressing fast: Disease resistant chickpea, and insect resistant sorghum



At ICRISAT, we have been trying to develop transgenic crops for dryland. Groundnut plants with virus resistance have been developed with coat protein genes. Progress is also made in other crops. For example, a poster in this meeting will describe our work on production of transgenic sorghums. Working with several advanced research institutions around the world, and with local scientists, we are able to target several useful genes to build insect- and disease- resistant crops for deployment in the near future.

The figure shows the various stages of transgenic sorghum. You can see the details in the ICRISAT poster during this conference.

A. Gus expression in transformed sorghum callus.

B. Regeneration of transformed callus.

C. Gus expression in T-zero anthers (Up-normal; down-transformed)

D. Regenerated putative transgenic plant.

E. Southern blot showing integration of GUS gene into sorghum.

Examples of Available GM Crops

- Corn and cotton resistant to insect pests
- Tomatoes and cantalopes with long shelf life
- Soybeans and sugar beets resistant to herbicides

Some examples include : Corn and cotton resistant to insect pests, Tomatoes and cantalopes with long shelf life, Soybeans and sugar beets resistant to herbicides.

Insect Susceptibility in Normal versus Bt. Maize

Let me provide a couple of specific examples to illustrate the benefit of GM crops. In maize the introduction of Bt. Gene can dramatically decrease the incidence of borer damage. In this picture, on the left is a control plant damaged by borer, and on the right is a GM plant nearly free of any symptoms of damage in spite of artificial infestation with the borer larvae.

Long Shelf Life of Tomatoes

Similarly, the shelf life of tomatoes has been extended by adding a gene to prevent or slow down the senescence process.

Why Developing Countries Need Transgenics

- Greater crop area, variety of crops
- Better crop protection
- Greater need for more food and nutrition

It is very likely that developing countries may benefit more from transgenics because of greater scope and need for growing a wide range of crops for multiple purposes. The existing need and the ready market also serve as incentives for the judicious use of the new technology.

GMO Issue: Summary

GM foods can help

- Solve problems of hunger
- Protect the environment : increase yield and reduce reliance on pesticides

Technology too valuable to be ignored !

Let Us Prepare To Welcome It, With Due Regard for Consumer and Environmental Risks

Genetically-modified foods have the potential to solve many of the world's problems of hunger and malnutrition and environmental degradation and to help protect and preserve the environment by increasing yield and reducing reliance upon chemical pesticides and herbicides

If properly used transgenics can be safer, better, and offer much promise for the future. As a technology, it is simply too valuable to ignore.

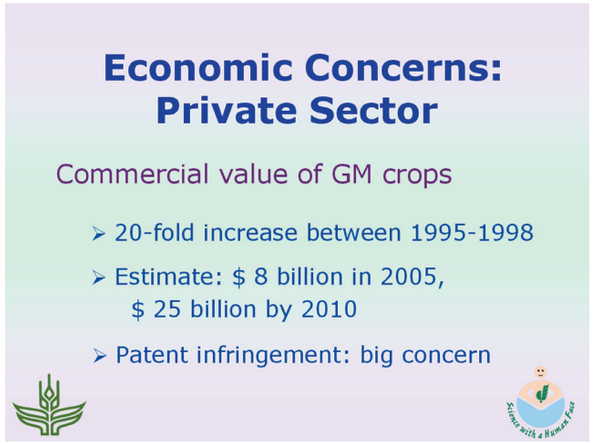
Therefore, adequate preparations to ensure its safe use for the benefit of those who are in desperate need of basic human requirements must be made.

GMO Issue: Summary (Continued)

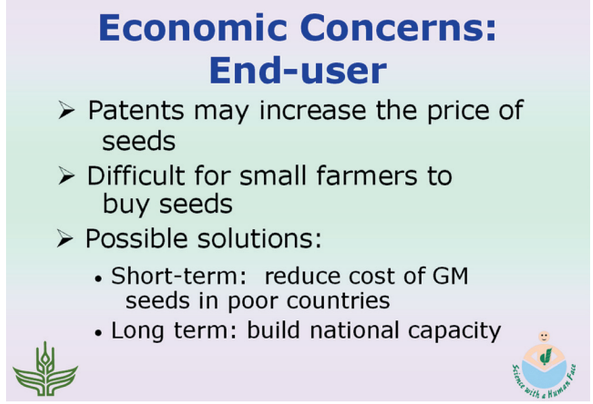
- Evaluate risks before GMO release
- Conduct open discussion with public to develop GMO policies
- Consult the public right from the beginning

As GMOs can significantly differ in important respects from naturally occurring organisms, potential risks should be evaluated before GMOs are approved for release.

Policies on GMOs will have to be based on an open and honest debate involving a wide cross-section of society right from the beginning, so that resources are directed towards socially acceptable goals, products, and delivery mechanisms. Research institutions and policy-makers should foster a dialogue to arrive at just and scientific conclusions keeping the national developmental needs in perspective.



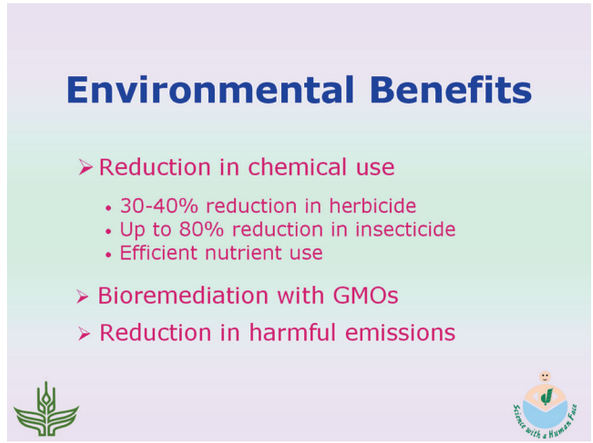
While the private sector, especially the big international companies, are increasing their investment, they want to ensure a profitable return. Patent infringement is one of their big concerns. However, the attempt to protect seed industry interests with "suicide gene" GM plants (terminator gene) has become very unpopular. Patent enforcement may also be difficult when transgenic and non-transgenic crops are grown close to each other (e.g., in the developing countries).



From the perspective of the end-user, especially in the developing counties, patents may raise the price of seeds so high that small farmers and third world countries will not be able to afford seeds of GM crops, thus widening the gap between the wealthy and the poor.

Two solutions can be suggested:

- In the short-term, GM products can be sold at reduced cost to impoverished nations, and a moratorium should be continued on the 'terminator technology'.
- In the long term, the only solution is to build national capacity for biotechnology research.



Many GM crops can protect the environment by reducing the need for heavier doses of chemicals.

Bioremediation using GMOs is already a reality, for example use of bacteria to clean oil-spills in the ocean.

In the immediate future, however, most of the benefits in developing countries will come from the efficient use of soil nutrients by plants and animals, leading to reduction in harmful emissions to the environment.

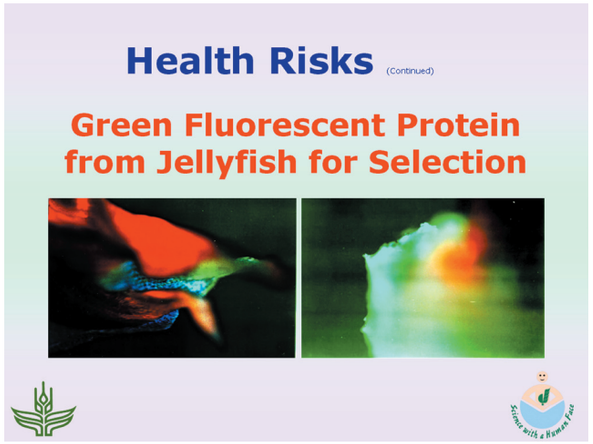
In spite of such advantages, why are some people still opposing GM crops? The reasons are

- Human health risks (fear of allergies, antibiotics, and toxic effects)
- Environmental risks (fear of harm to unintended organisms, or the development of super bugs and super weeds)
- Concerns related to national food security and fear of economic monopoly by multinational corporations.

As an example, we can consider the health risk of allergenicity.

However, please note that some people are already allergic to peanut butter and milk. Extensive tests are conducted before release of GM foods. For example, the GM food based on a Brazil nut gene was abandoned for this reason after being tested. The problem can be solved if the GM foods and food products are labeled.

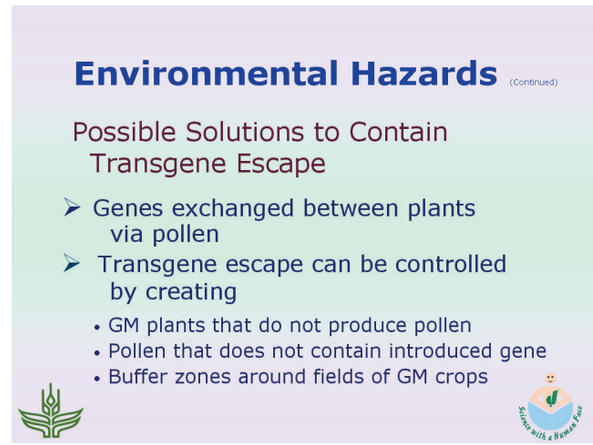
There is a concern that introduced genes into food plants may have an unexpected and negative impact on human health. A request paper published in *Lancet* examined the effects of GM potatoes on the digestive tract in rats and concluded that it was dangerous. However, the data were flawed as an inappropriate gene was used to make GM potatoes. Instead if lectin gene from garlic is used, the results would not have been the same.



Antibiotics and herbicides used as markers in the early years have also raised concern. However, nowadays these compounds are no longer used. New techniques such as fluorescent natural proteins from jelly fish or the mannose phosphate isomerase system of *Novartis* could be used instead, as shown above. The green sectors in this picture represent genetically transformed sorghum cells, and the red, untransformed.

Three types of environmental hazards are envisaged:

- Fears about the unintended harm to other organisms. For example, a report was recently published in *Nature* on a lab study that pollen from Bt. corn caused high mortality rates in monarch butterfly caterpillars. Subsequent large-scale field studies have shown that this was not the case.
- Concerns that insects will become resistant to transgenics crops. There are several strategies to manage this problem; use of susceptible refuges, rotation of different genes, and integration of transgenics within the IPM (Integrated pest management) approach.
- Risk of gene transfer to non-target species or development of "super weeds". Potential problems should be examined much before the release of the transgenic plants in any area.

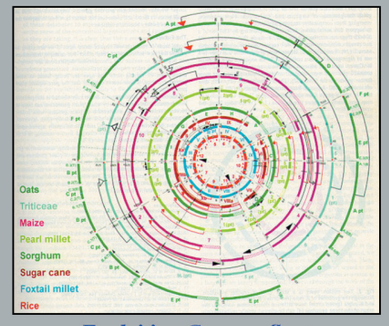


Since genes are exchanged between plants via pollen, one can create GM plants that do not produce pollen, which may be specially relevant to tuber crops or forest species. For field crops, GM plant that do not contain the introduced gene in pollen should be possible. A practical method under many situations is to create buffer zones around fields of GM crops.

Mr. Chairman, we have held many consultations this year with our Asian partners on sustainable natural resource management, and on watershed management in particular. We will continue to pursue our work totally in the context of partnerships, of listening and learning – and then by DOING, together, to build a better tomorrow for our children – through Science with a Human Face.

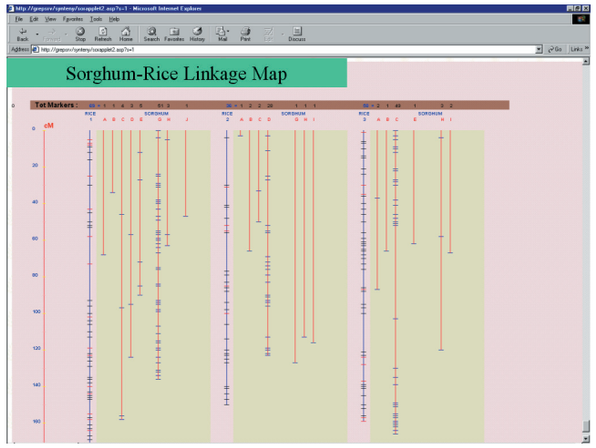
Thank you for your support.

II. Gene Mining: How One Crop Leads to Another



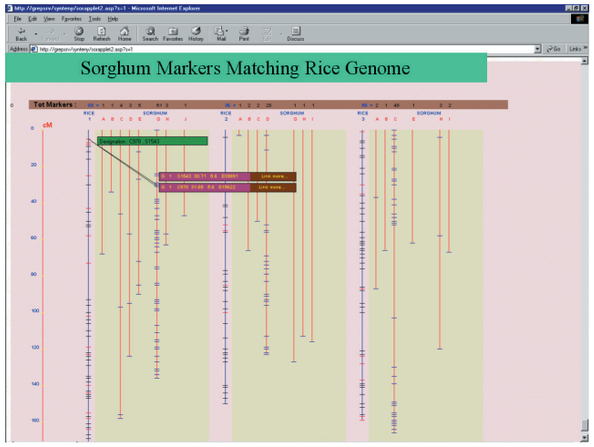
Exploiting Genome Synteny

The second step in the new science of diversity prospecting, is to mine these genetic pools to find valuable genes that we can put to use. Here, we benefit from an amazing pattern that we are still learning about, called 'gene synteny'. From studies of genome mapping around the world, we are learning that even in very different crops, many genes with similar functions appear to be located on 'homologous' linkage groups. This means that we can use gene maps for one crop, to give us a good idea of where to look for similar genes in other, less-studied crops – or vice-versa.



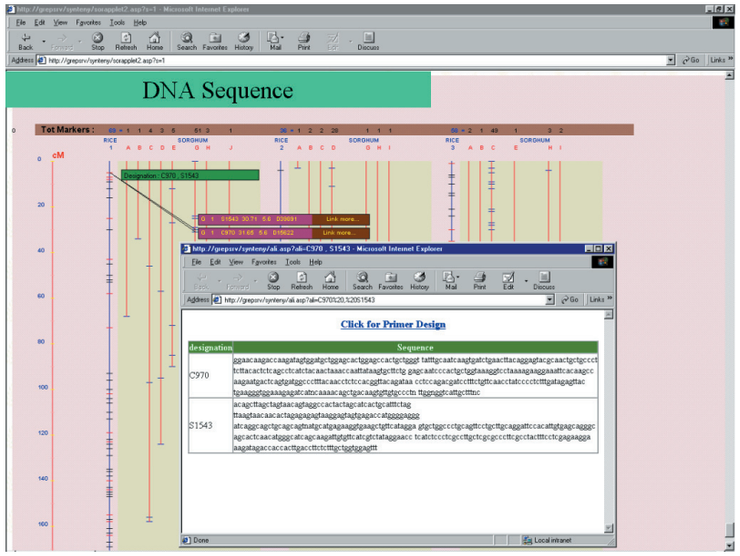
Japanese scientists, for example have studied the synteny between rice and sorghum. Here is a pictorial representation of three rice linkage groups, and the corresponding markers on linkage groups of sorghum. Most of the markers on rice linkage group 1, for example are also on sorghum linkage group G. Likewise, most of the markers on rice linkage group 2 fall on sorghum linkage group D, and so on.

So, when the rice researchers find an interesting gene on linkage group 1, sorghum researchers can look for the same trait on sorghum group G.



The other great thing about synteny is, that it can be exploited by posting these genome maps and their related gene sequencing data on the internet for free public access. The new tools of bioinformatics can then be used to compare gene sequences across crops.

Because of our interest in using rice information to help us breed sorghum, we developed some computer programs to graphically show the information that lies behind the genome map data posted by the Japanese. When we move the mouse button over a particular marker locus, we get more information. Red indicates multiple markers on the same location. Clicking on the marker in the green tab gives the DNA sequence information, in the next slide.



These DNA sequences can be compared to DNA sequences in other crops, taking advantage of another astounding discovery - that some genes in widely different crops seem to show similarities in their structure and function. This correspondence has been found for disease resistance genes, even across bacterial, fungal, viral, or nematode pathogens.

Since we are politically neutral, non-profit, and international, we can help our partners in Asia in some critical areas, which we describe as our 'bridge, broker, and catalyst' roles:

- As a Bridge, we can help in fostering north-south, and south-south exchanges of technologies and information.
- As a Broker, we can help stakeholders find win-win solutions for example when communities need to make tradeoffs between upstream and downstream resources in watershed areas.
- As a Catalyst, we can stimulate and convene international initiatives to attack difficult scientific problems that are beyond the means of any individual institution, and which have broad regional or even global consequences affecting all of us.

Specifically, we see our major contributions as a partner in these consortia in the areas of:

- Soil/water/nutrient management technology
- GIS/remote sensing
  - Systems models; and
  - Community development models.

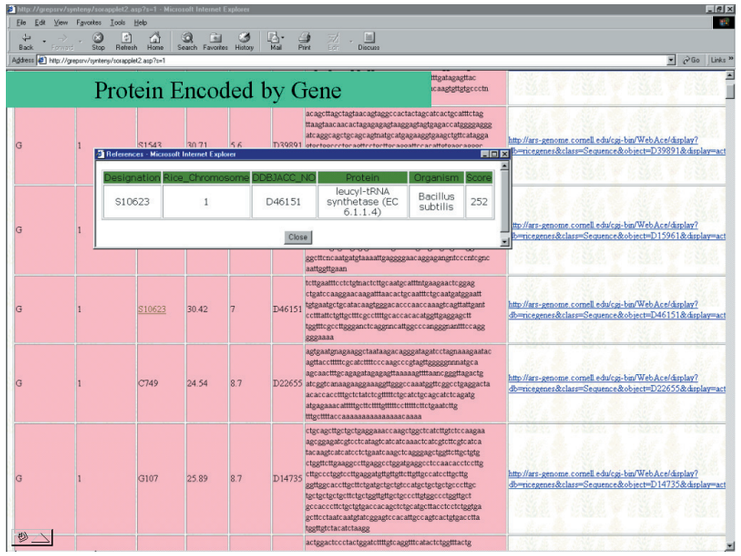
We see the introduction of legumes as a way to help alleviate poverty and malnutrition, fitting our focus on doing 'Science with a Human Face'.

In addition to raising soil fertility, legumes bring a number of socioeconomic benefits. They increase farm incomes; diversify the sources of that income; and deliver more benefits to women, who are the main cultivators of food legume crops.

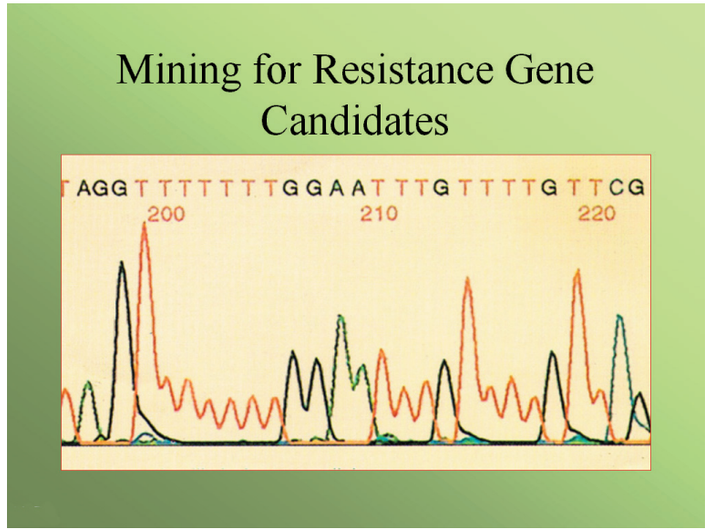
Legumes also improve human nutrition, and we know that women and children are the most at risk of malnutrition among the poor, so this is another important way we can combat poverty and inequity.

We see APAARI as an essential partner for improving natural resource management in the region. To name just a few, we see major opportunities for this partnership to enhance research coordination, foster information sharing, encourage lateral transfers and impacts of technologies, and to advocate policies to governments for better stewardship of land, water and nutrient resources in the region.

ICRISAT and APAARI members are working through two major networks to achieve these goals: the Cereals and Legumes Asia Network (CLAN), and the Rice Wheat Consortium (RWC).



And clicking again gives the protein information that the sequence codes for. In this case it is leucyl tRNA synthetase. So this tells us what is known so far about the actual function of the gene.



In a practical example, the correspondence between the peaks and valleys on this graph indicates similarity of some DNA sequences we found on the internet, to the DNA sequences of our downy mildew resistance genes in pearl millet.

In this way, we made a large number of comparisons of gene sequences across all our mandate crops, using the 'BLAST' (basic local alignment search tool) with the free public databases of the USA's National Centre for Biotechnology Information (NCBI).

EXTRA DETAIL (FOR REFERENCE ONLY):

In general, R genes contain specific structural features which are nucleotide binding site (NBS), leucine rich repeats (LRR), and a serine /threonine protein kinase. These are considered to be components of a signal transduction pathway which is common to a defense response. The sequence similarity among the resistance genes from different plant species has made it possible to isolate such resistance gene candidates (RGCs) from any plant species of interest using PCR (polymerase chain reaction) with oligonucleotide primers to the conserved domains of the resistance gene classes mentioned above. This 'candidate gene approach' has been successfully used in a variety of species including soybean, potato and lettuce to identify resistance gene candidates.

We used the above mentioned approach to identify RGCs from the ICRISAT mandate crops, sorghum, pearl millet, chickpea, groundnut, and pigeonpea. By using the degenerate oligonucleotide primers designed to the conserved motifs in the NBS region using PCR we amplified DNA fragments from the crop species mentioned. The amplified DNA fragments were cloned, sequenced and BLAST searches were performed via the National Centre for Biotechnology Information (NCBI) run by the National Institute of Health, web site to look at the similarity with the known genome sequences in the GenBank databases. We identified several such disease resistance gene candidates (RGCs).

Resistance Gene Candidates

- 24 resistance gene candidates identified so far across five crops (sorghum, pearl millet, groundnut, pigeonpea, chickpea)
- Demonstrates the value of free bio-information in the public domain

We have so far found 24 resistance gene candidates across all of our mandate crops. All of these sequences have been deposited in the GenBank database with distinct accession numbers.

This is yet another example of why it is important to keep basic genomic data in the free public domain. We learn from advanced institutions and countries, and they learn from us. I think we'll hear more about this in Dr. Craig Venter's Crawford Memorial Lecture on Thursday evening.

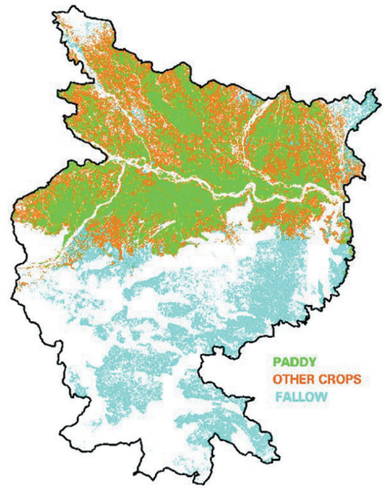
Rice Fallows: Huge Potential for Legume Diversification

Country	*Rice fallow area (million ha)*
India	11.7
Bangladesh	2.4
Nepal	0.4
Pakistan	0.1
Total	*14.6*

Rice fallows are yet another huge untapped opportunity for Asia. There are 14 1/2 million hectares of land in Asia left fallow after rice.

In much of this area, the constraint is that farmers don't have crops that can grow and mature quickly on the residual soil moisture. We have bred ultra-early maturing chickpea and pigeonpea varieties that can fill this niche and greatly increase farm incomes while improving family nutrition.

Satellite Imagery of Rice Fallows in Bihar



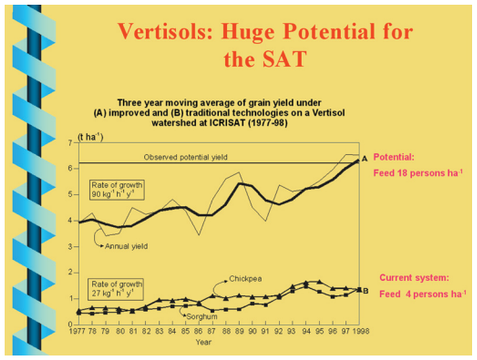
The vast potential for rice fallows is apparent in this satellite image of Bihar, India.

In the lowlands, where there is plenty of irrigation, farmers grow a second crop of rice in the dry season, as shown in green. But in the marginal rainfed areas where water is more scarce, they fallow these ricelands in the second season, shown in blue.

By planting these fallow areas to quick-growing, drought-hardy legumes, we can have major impacts on a huge area. For example, this strategy is now a big success with chickpea in the Barind zone of northwestern Bangladesh.

An integrated approach has to consider the communities who inhabit the watersheds where the soil and nutrient resources are managed.

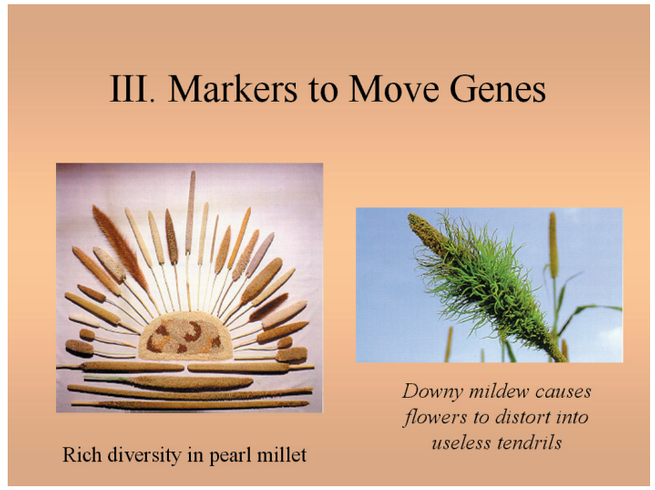
These watershed communities form the core of our strategy. We are working with them through partnerships with regional, national, and local institutions to find practical ways to improve water harvesting and water management. At the same time, we are seeking ways to enhance soil fertility such as by introducing legumes and through better fertilizer and organic matter management. This will raise and stabilize farm incomes, so farmers are rewarded and motivated to take better care of their land in the future.



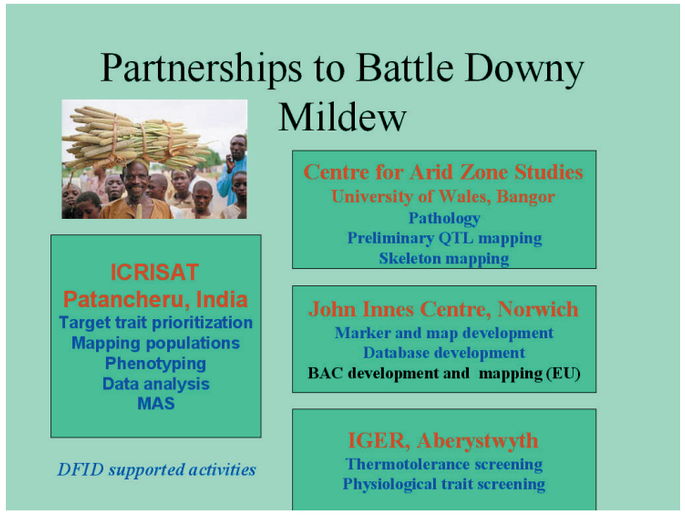
The Vertisol or black cotton soils occupy 1.49 million square kilometers in the semi-arid tropics. These rich, fertile soils are a huge agricultural opportunity for the poor – yet, their potential is far from being realized.

In long-term trials, we have demonstrated that these rich soils have the capacity to feed 18 persons per hectare of land cultivated (4.7 t/ha food per annum), but at present they are only productive enough to support four persons (0.9 t/ha).

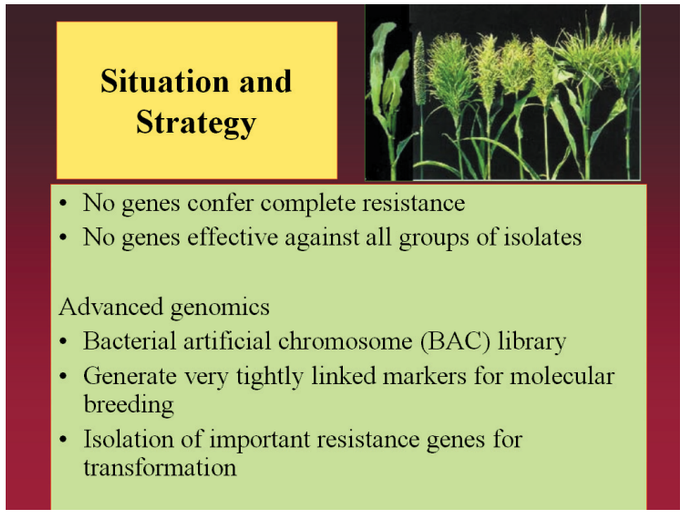
We have also found techniques that can double rainwater use efficiency (67 vs 30%), decrease water losses from runoff and deep percolation (33 vs 70%), reduce soil loss by 75%, (1.5 vs 6.4 t ha^{-1}), and increase carbon storage in the soil – helping against global warming.



I'll now turn to the third facet of the new frontier approach – using molecular markers for more targeted transfers of genes into cultivated crops. I'll continue with the example of genes for resistance to downy mildew disease in pearl millet. Pearl millet is the staple food crop of the poorest of the poor in the very driest areas of tropical Africa and Asia, along the desert margins. This disease is the most serious biotic problem of the crop, caused by the fungus *Sclerospora graminicola*. It causes the panicles to distort into a barren tangle of green tendrils.

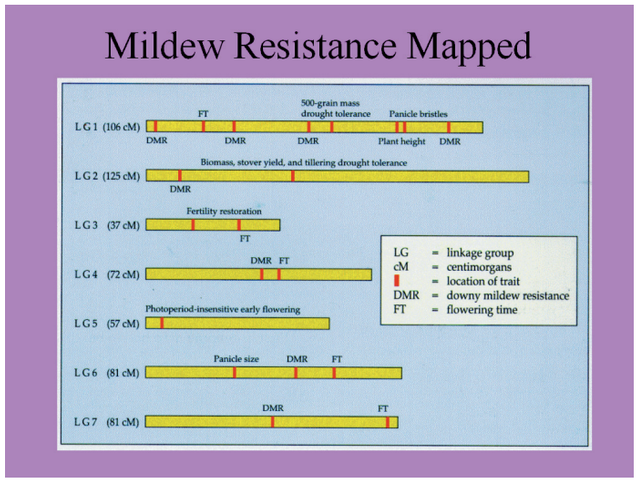


As for the other examples I've mentioned, international partnership is key to progress. In this case, we depend on close collaboration with three institutes in the UK.

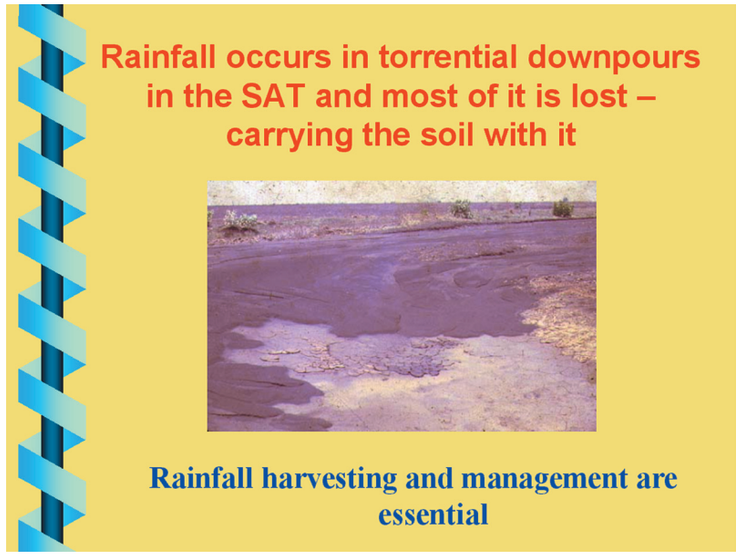


Like many fungal diseases, the host and pathogen have co-evolved such that different races predominate in different geographical areas. No single resistance gene is effective everywhere. For more durable resistance, our strategy is to try to understand the diversity of the pathogen, and to pyramid multiple resistance genes so that races prevalent in a given region are not likely to be able to break them down.

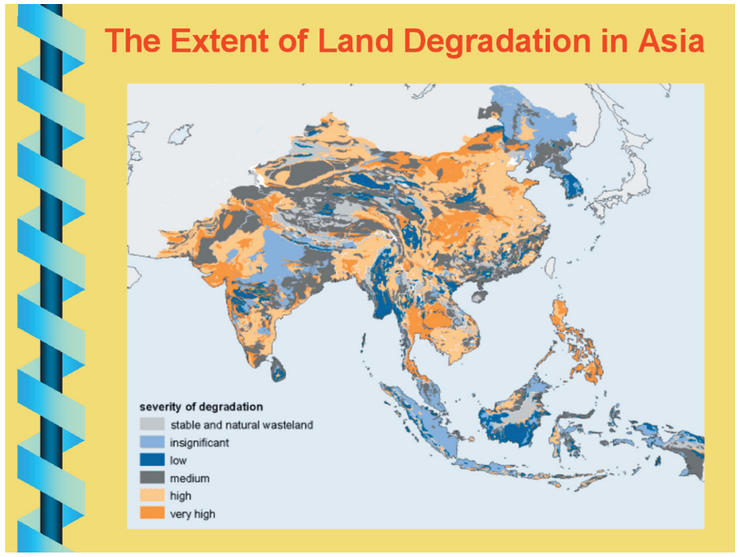
Using new frontier techniques, we are mapping important resistance genes so we can consciously select for them. Ultimately, we would like to isolate these genes so we can even move them directly into elite plant types using genetic transformation technology.



Over the years we've used conventional techniques to map a number of important genes, including resistance to downy mildew. With our partners, we've associated molecular markers with these resistance genes on linkage groups 1, 2, 4, 6, and 7. This is why we call it a quantitative trait, and we manipulate it using QTL (quantitative trait loci) approaches.



The key to sustainable watershed management is to protect the land. If we lose the soil resource, there is little we can do later to restore it. Rainfall in the SAT comes in torrential downpours, all too often carrying with it significant quantities of soil. Farmers need ways to control runoff, decrease erosion, increase infiltration, and conserve excess water for later use.



This GIS figure shows the extent of land degradation in Asia. The brighter orange areas are most severely degraded, and the grey areas moderately degraded. High population density is not necessary related to land degradation. Land degradation is driven by socioeconomic causes. People can be either part of the problem – OR part of the solution. This is where policy and incentives have an important role to play, along with education.

The successes of the Green Revolution are well known. Production of staple grains, especially rice and wheat, doubled and prices fell by more than half, benefitting the poorest consumers.

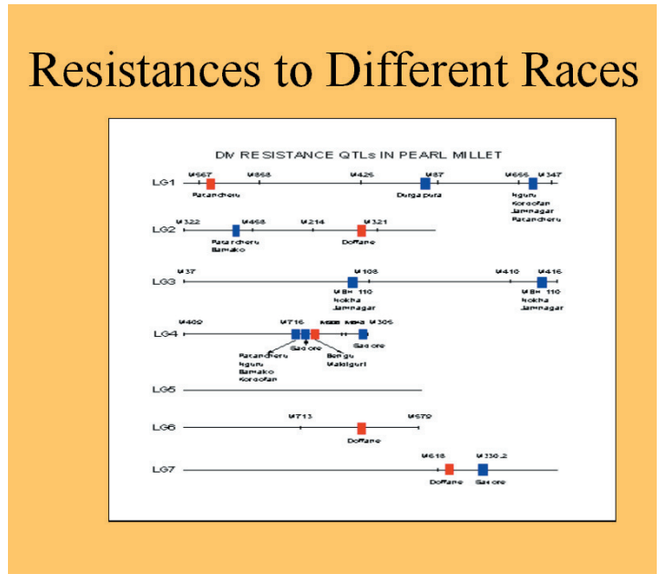
Nevertheless, there is now great concern that the Green Revolution regions are showing signs of yield stagnation, nutrient and water imbalances, and increased pest and disease problems.

And many farming areas were bypassed by the Green Revolution, because they are too dry, have poor soils, are too remote, or for other reasons were considered 'marginal.' This is where poverty remains concentrated, and we must do something about it.

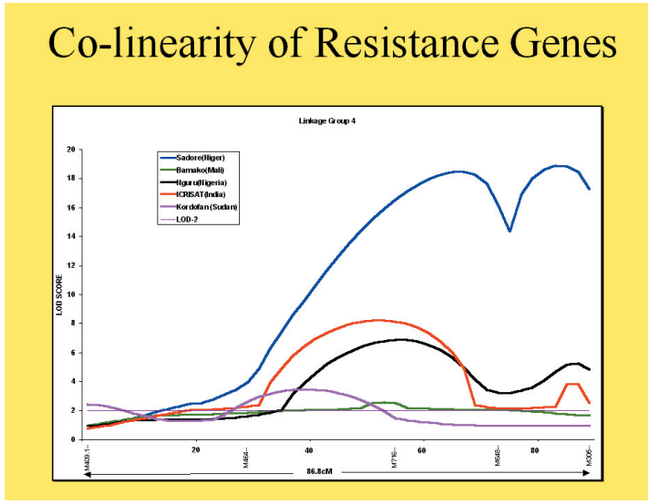
For rainfed areas in the SAT the major challenge is and will continue to be water scarcity. IWMI estimates that 33 per cent of the populations of developing countries will be affected by severe water scarcity by 2025, including one billion of the world's poorest people living in semi-arid and arid lands. What can be done about this?

One thing is to increase the efficiency of water use. Today, only about one-third to one half of the rain that falls on agricultural lands in the dry tropics is effectively used by crops – the rest is lost. These crops need to grow vigorously to extend their roots and provide leaf canopy cover so they can better use the water resource. This requires good soil fertility.

So the problems of water use and soil fertility are closely intertwined, and have to be addressed in an integrated manner.



This shows graphically the resistances to two different Indian races of downy mildew. You can see for example that they are clustered close together on linkage group 4.



Carrying this further, we used statistical techniques to find that resistance against isolates from five different countries covering both Africa and Asia, all had some genes clustered on that same linkage group 4 of pearl millet. Curves that rise above the LOD 2 baseline, reflect a statistically significant match.

By finding and mapping these different genes, we set the stage for much more efficient resistance breeding using molecular markers.

In this way, we've already moved several different resistances into lines that are under test by national and private sector breeding programs in India. This continues a tradition of achievement for which ICRISAT is well known - we played a major role in preventing the collapse of millet farming in the country because of downy mildew, and were recognized for this by the CGIAR with the King Baudouin Award in 1996.

In addition to downy mildew, we expect major achievements in the near term on drought tolerance, and on stover quality for livestock feed (in collaboration with ILRI).

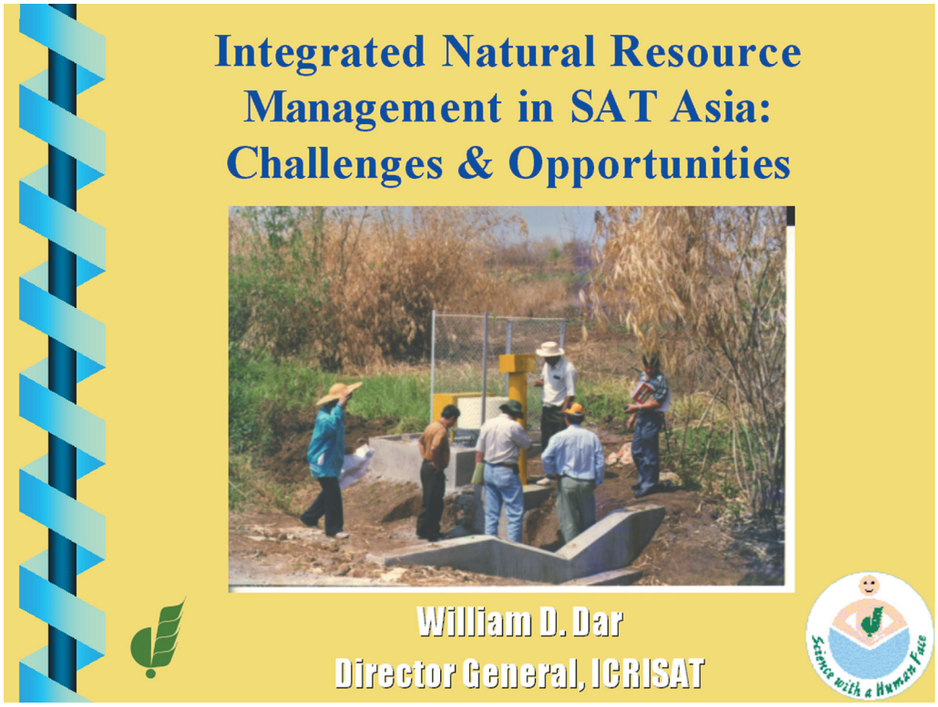
But much remains to be done, as President Clinton pointed out in his recent visit to Hyderabad

Mr. Chairman, ladies and gentlemen, I would summarize by saying that we are very excited about the potential of new frontier techniques for diversity prospecting. We see great benefits to the poor as these techniques are mainstreamed over time. But this will require close partnerships with open sharing of information. The CGIAR should play a leadership role in fostering this bright future.

Thank you very much.

Integrated Natural Resource Management in SAT Asia: Challenges and Opportunities

– presented at Thailand, and Malaysia, 10 November 2000



At ICRISAT, we see our role as helping our regional, national, and local partners to extend the successes of the "Green Revolution" to those who were bypassed – those living in the drier, marginal areas. To do this, we will need to work even more closely in scientific partnerships for the sustainable development of natural resources.

Information technology will also have a huge impact in helping farmers adapt their crops and management to their environment.

Initiatives like the Village Knowledge Centers established by the M. S. Swaminathan Institute in Pondicherry are allowing farmers to get vital information about weather, disease and pest epidemics, input and market prices, crop management advice, and many other things.

Farmers will also use these channels to feed back to researchers and policy-makers. No longer will the rural poor be ignored by those in power.

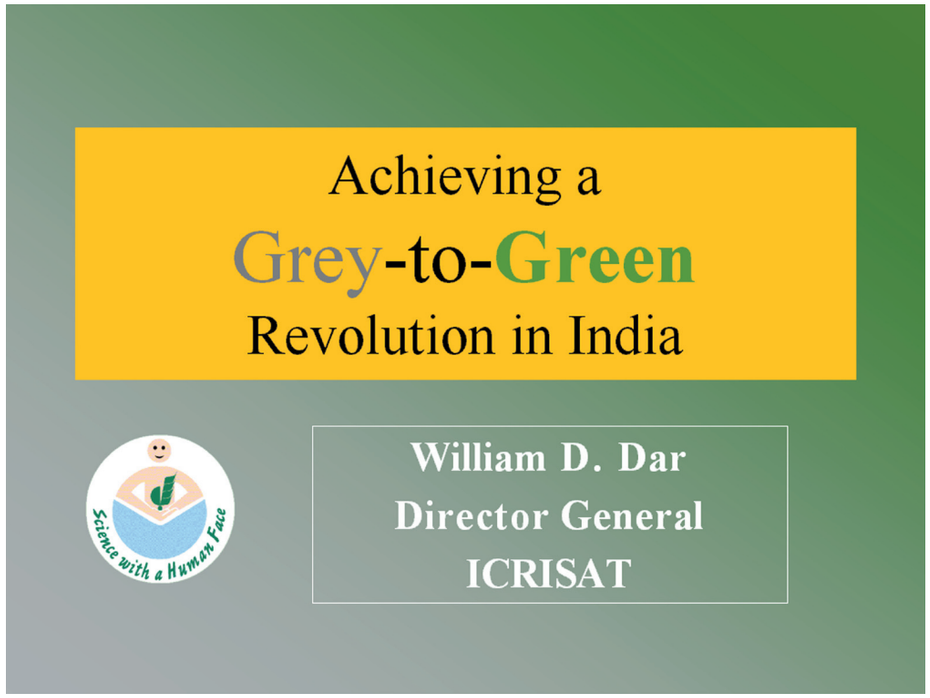
Mr. Chairman, ladies and gentlemen, I believe that as fantastic as the Green Revolution was, we are on the cusp of an even bigger revolution – a Grey-to-Green revolution that adapts crops and systems to the environment, not the other way around. We have the tools – the amazing tools of biotechnology and information technology – and we have the will – a commitment to Science with a Human Face.

Let us work together so that India leads this revolution, and becomes a beacon of hope for similar dry areas across the developing world.

Thank you very much.

Janareddy Venkatareddy Memorial Lecture

– presented at the Acharya N G Ranga Agricultural University, Hyderabad, 1 December 2000



Ladies and Gentlemen,

First of all I would like to thank you most sincerely for inviting me to present the "Janareddy Venkatareddy Memorial Lecture" for the year 2000. It is indeed an honor.

Many of you have heard of the Green Revolution. I want to speak to you today about the possibilities of extending this amazing achievement to the areas that were bypassed the first time – to the 'grey' areas. They are called 'grey' because they are dry most of the year. They lack a sufficient amount of that fundamental input that is so critical to agriculture: water.

But first let me review briefly that heroic achievement that we are hoping to emulate: the Green Revolution.

It is difficult to put in words how important the Green Revolution was for humanity. If it had not occurred, an extra billion people would be hungry today. It is one of the shining achievements of our time.

It all began in 1945 when the Rockefeller Foundation sent a small team of agricultural researchers to Mexico. They were led by Norman Borlaug, who developed shorter, much higher-yielding wheat varieties.

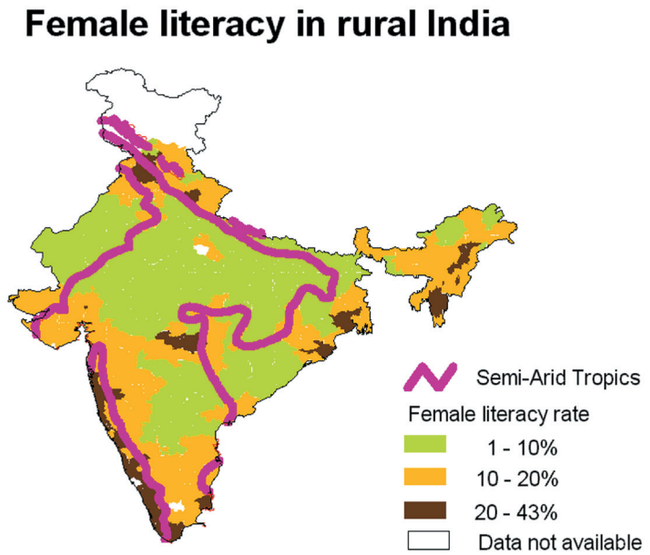
Dr. Borlaug won world acclaim, and was awarded the 1970 Nobel Peace Prize for his achievement.

Dr. Borlaug is revered across India, and is still a highly honored guest when he visits us at ICRISAT.

At about the same time, rice researchers such as Peter Jennings and Hank Beachell were having the same spectacular success by breeding higher-yielding rice varieties.

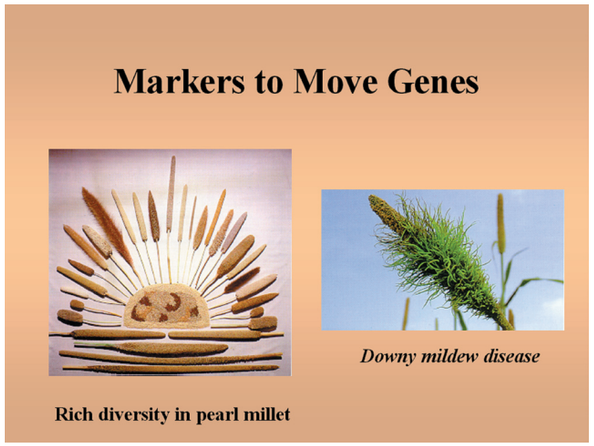
The Green Revolution prevented massive famines that were predicted to be inevitable in India during the 1970s.

The Green Revolution was truly a great success story for science in the service of human development.



Women are especially disadvantaged within these dry areas – as you can see, the rate of female illiteracy tends to be highest in the central parts of India, which is the dry zone. Female illiteracy is not only a concern in itself – but it also correlates with many other measures of poverty and deprivation.

So the Grey-to-Green Revolution holds especial potential to help poor women.



Biotechnology has a huge potential to accelerate progress. We have used the new technology of molecular markers to find resistance genes against many races of the downy mildew disease of millet. We were recognized with the CGIAR King Baudouin Award, the highest award of our global system of sixteen Centers, for this achievement.

The Green Revolution rices and wheats depended on farmers having access to favorable environments to avoid any moisture or nutrient stress. But the lesson we have learned in the marginal dry tropics is the opposite - that great productivity gains can be made by adapting the crop to the environment, through better stress, disease, and pest resistance or avoidance.

For example, Japanese scientists helped us discover that pigeonpea is more efficient than other crops in extracting phosphorous from the soil. In addition of course it fixes atmospheric nitrogen. By using their own on-farm genetic resources to build their soils, farmers are practicing sustainable natural resource management.

In this way we are enhancing productivity and catalyzing a Grey-to-Green Revolution.

Many were also concerned about the gender impacts of the Green Revolution – that the beneficiaries were men, not the women and the children who depend on them.

However, many farm tasks are carried out by women, and in many cases women control key operations and cash flows in farming, such as postharvest operations, marketing, and the cultivation of crops around the household. Researchers are now putting extra emphasis on women's crops and operations so that more of the benefits flow to them.

The core of the achievement was the reduction in plant height. This stimulated more nitrogen responsiveness and a higher percentage of total biomass being expressed in the grain – in other words, higher yields.

This discovery radically reshaped agricultural production around the world.

In less than a decade, the developing world went from famine to feast. And the Revolution continues.

The Green Revolution doubled production and increased production efficiency so much that prices for rice and wheat has now declined by more than 70 percent in real terms since the 1970s.

The price decline was of especial value to the poor, who spend a higher proportion of their incomes on food than do the wealthy.

While acknowledging the contributions of the international Centers, it is important to emphasize that the Green Revolution would never have occurred without the strong actions of national and local governments and research and development agencies, as well as NGOs and the private sector.

In particular, we honor M. S. Swaminathan's role in India. Norman Borlaug himself praised India's national research system.

Similarly in my own country The Philippines, our national institute PCARDD played an active and effective role –as did others across the developing world.

It is true that one of the features of the green revolution cereals is that they are more responsive to inputs, such as good water management and fertilizer. Some worried that this delivered benefits mainly to the richer farmers that could afford these inputs.

However, studies in The Philippines and in the Punjab region of India found that millions of small farmers directly benefited, and were not forced off their land or into poverty by the wealthier farmers.

To make a long story short, our impact in marginal areas took some time in coming because of the complexity of these environments –but that impact has been enormous already, and is increasing rapidly.

By showing that it CAN be done, we are dispelling the myth that research in marginal environments doesn't pay off.

And this isn't just our opinion. A recent study by the Asian Development Bank (2000) 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."

The same report found in its extensive survey that development projects had much higher impacts when they included a research component.

We have had major impact in breeding millet in India. Most of the millet is now F1 hybrid, based on ICRISAT's downy mildew resistant inbred parents. Our impact on millet is also increasing rapidly in Africa.

We and our partners developed early-maturing, wilt-resistant chickpea varieties that extended cultivation further south than ever before – 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.

Still, it is clear that more favorable agro-ecozones, with ample water and capital resources, were able to more fully exploit the potential of the Green Revolution than could the harsh, dry areas.

Many worried about the inequity of this. Dry zones were being left behind.

Despite the Green Revolution, there are still about 840 million people, or 13 percent of the global population, who are food insecure. The greatest extent of food insecurity is in South Asia, where 48% of the population is chronically malnourished. Unfortunately, Africa is rapidly catching up too.

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 by 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 harsh, dry areas where the high yield responsiveness of those varieties could not be expressed.

In many ways, this challenge – to create a Grey-to-Green Revolution - was even greater than the Green Revolution.

Some argued that we should forget about these areas and concentrate agriculture in the favorable areas, where it is most highly productive.

This may have merit from a simply biophysical viewpoint, but what about people? They live in these areas and this is their home, their past and their future. Where should they go? Should we just abandon them?

I believe our science should have a human face – and we should not turn our face away from them.

Responding to the call, the international system created two CGIAR Centers focused on these dry marginal areas – my own institute, ICRISAT, for the dry tropics; and our sister Center ICARDA for the dry temperate latitudes.

This is ICRISAT's headquarters near Hyderabad. The center of the Indian peninsula is a dry tropical area with hundreds of millions of rural poor.

Losses to pod borer worms in pigeonpea amount to billions of dollars annually across Asia and Africa. This is a difficult scientific challenge we are working on now. The new tools of biotechnology may help us overcome this voracious pest. When we do achieve this breakthrough, the impacts will be huge and very positive for the environment – because farmers will use less toxic insecticide.

Integrated pest management can also have major impact –such as encouraging natural enemies to attack pod borers, and using bio-friendly pesticides.

By genetically controlling major diseases of crops – such as Fusarium wilt of pigeonpea shown in the middle here – huge productivity gains could be made in these dry areas.

This was one of the first major impacts of ICRISAT, working hand in hand with government agencies in India. The resistant ‘Maruti’ variety is widely grown across the center of Peninsular India including western Andhra Pradesh, eastern Maharashtra, and northern Karnataka states.

Downy mildew causes millet florets to deform into useless tendrils

If diseases of millet such as downy mildew could be brought under control, huge benefits could be delivered directly to the peoples who grow and eat this crop – the rural inhabitants of the marginal areas.

And with our national partners in India, we have done this too.

The challenge for the research community, in the wake of the Green Revolution, was to create a new way of thinking about marginal areas –to see the glass not as half empty, but as half full. To imagine how the problems of these areas could be turned into advantages.

Here for example in a stony, eroded area the farmer has turned the natural challenges to his advantage – using the stones to create terraces to conserve extra moisture.

Another positive is that these areas have plenty of sunshine and drier weather helps control pests and diseases – both of these are positive factors for agricultural production.

Animals tend to do better in this zone too, for the same reasons – fewer diseases and pests. And animals provide year-round income, to balance out the crops which only produce once or sometimes twice a year. We work closely with our sister Center, the International Livestock Research Institute, to breed crops that are more nutritious as animal feed.

And the genetic resources of the dry areas are another source of wealth and opportunity – drought-hardy crops like chickpea which use only a twelfth as much water to produce a unit of grain, as compared to rice.

Millet and sorghum are the drought-resistant cereals of the dry tropics. They account for more cereal production than any other crops in West Africa. They are still the daily staple foods for 50 million rural people living in the dry center of India, too.

So we see that these marginal areas in fact have many positives, and create opportunities if we look closely enough.

ICRISAT's research on watersheds, for example has shown that one can quadruple yields 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.