



Towards a Prosperous, Food-secure and Resilient Dryland Tropics

A Compendium of Speeches by
William D Dar
January-December 2011

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**International Crops Research Institute
for the Semi-Arid Tropics**

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Contents

Biographical sketch	v
Foreword	viii
IMOD: Innovate • Grow • Prosper •	1
Partnerships the key to innovations in agricultural biotechnology	5
Yes we did, and we will deliver!.....	9
Capacity building: A pathway to greater crop productivity	13
Legumes the answer to food security in India and Myanmar	17
Innovation is key to growth	21
Breeding by design: No longer a dream.....	23
Biodiversity, genomics and climate change: “Science with a human face” perspective	25
Innovation is key to agricultural growth and prosperity.....	29

Innovation and entrepreneurship: Keys to inclusive agricultural growth	35
Collective action critical to successful value chain innovations	39
Fueling pulse productivity through genomics	43
Information system the crux of knowledge-intensive crop research	47
Leading the path to sustainable and inclusive agricultural growth	51
Harnessing biofuels for enhanced smallholder livelihoods	57
Making bio-energy opportunities work for the poor	61
Dryland Cereals Spell HOPE for the poor in South Asia.....	65
From pessimism to possibility: Ushering in a second Green Revolution	69
Crop biotechnology in the fight against poverty and hunger	73
Harnessing innovation & entrepreneurship for inclusive agricultural growth	79
Technological empowerment and sustainable livelihood for smallholder farmers	83
Building climate-resilient rainfed agriculture through sustainable adaptation measures	87
Harnessing Plant Growth-Promoting Rhizobacteria (PGPR) for sustainable agriculture	91
Improving pulse productivity through genomics	101
Together harnessing crop diversity to benefit smallholder farmers	105
Climate change and its impact on agricultural productivity and livelihood: Technology and policy response.....	109
Working with farmers is a must	115
Water management for sustainable agricultural growth	119
Agribusiness incubation for inclusive and sustainable agricultural growth.....	123
Agribusiness and food processing: Creating opportunities via partnerships.....	127
Team ICRISAT: Together we can make things happen.....	131
Innovate • Grow • Prosper • Feeding the forgotten poor.....	135
Come, share in my pride!	139



Biographical Sketch

William Dollente Dar, PhD, is Director General of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) near Hyderabad in Andhra Pradesh, India, since January 2000. ICRISAT is a non-profit, non-political and pro-poor institute and a member of the Consortium of CGIAR Centers.

Dr Dar holds the distinction of being the first Filipino and Asian to be Director General of ICRISAT. With his outstanding leadership as Chair of the Alliance Executive (2005), the Alliance of Centers was made the third pillar of the CGIAR system. He was Chair of the Committee on Science and Technology (CST) of the United Nations Convention to Combat Desertification (UNCCD) from 2007 to 2009. Dr Dar was also a Member of the UN Millennium Task Force on Hunger.

Prior to joining ICRISAT, he served as Presidential Adviser for Rural Development, and Secretary of Agriculture in the Philippines (equivalent to Minister of Agriculture), the first ever alumnus of the University of the Philippines Los Baños (UPLB) to become one. Before this, he was

Executive Director of the Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD) and Director of the Bureau of Agricultural Research (BAR) of the Philippine Department of Agriculture (DA).

Dr Dar also served on the governing boards of the Australian Center for International Agricultural Research (ACIAR) and the CGIAR's International Maize and Wheat Improvement Center (CIMMYT) as well as of ICRISAT. Moreover, he was Chair of the Asia-Pacific Association of Agricultural Research Institutions (APAARI) and the Coarse Grains, Pulses Research and Training (CGPRT) Center based in Indonesia.

Dr Dar received a Doctor of Philosophy (PhD) in Horticulture from the University of the Philippines Los Baños and an MS (Agronomy) and BS in Agricultural Education from Benguet State University (BSU) in La Trinidad, Benguet, Philippines. He taught at BSU for 11 years and rose from the ranks to become full Professor and Vice President for Research and Extension.

Dr Dar has been the recipient of several honorary doctorates – Doctor of Humanities from Pampanga Agricultural College (PAC) and Doctor of Science



(Rural Development) from University of Southern Mindanao (USM), Philippines (2011); Doctor in International Agricultural Development from Central Mindanao University (2010); Doctor of Technology from Isabela State University (ISU) (2008); Doctor of Resource Management from Benguet State University (2007); and Doctor of Science from Mariano Marcos State University (MMSU), Philippines (2003).

He has received a number of awards and honors, including the Ten Outstanding Young Men (TOYM) of the Philippines, Outstanding Young Scientist of the Year, Crop Science Society of the Philippines' Achievement Award for Research Management and Outstanding Science Administrator given by the Philippines Department of Science and Technology (DOST). He was also awarded as Distinguished Alumnus of UPLB and the Most Outstanding Alumnus of BSU and the Ilocos Sur Polytechnic State College (ISPSC). In 2002, PCARRD honored him with its highest and most prestigious award, the Symbol of Excellence in R&D Management.

In 2003, the Vietnamese Government honored him with the, "For the Sake of Agriculture and Rural Development in Vietnam Award" while the Philippines' DA-BAR awarded him with a Plaque of Recognition for his outstanding performance as its First Director. He is also the recipient of the "Anahaw Leaf Award" for being the Most Outstanding Alumnus of the ISPSC High School Class of '69.

In 2004, the Central Luzon State University (CLSU) in the Philippines awarded him the Golden Grain Award, commending him for his "deep concern and intense advocacy for the promotion of a global yet equitable program for food security and reduction of poverty through pioneering scientific and technological innovations".

In the same year (2004), he was given the Research Leadership Excellence Award, the most prestigious award of the Philippine Association of Research Managers (PhilARM). In 2005, he was given a plaque of recognition by the Philippine Department of Agriculture for his outstanding contributions when he was Secretary of Agriculture. In 2006, he was awarded the "KALSA: The Most Distinguished Alumnus Award" by BSU in recognition of his being the first Filipino and Asian to serve ICRISAT and for the heights he has reached in the management of research and agricultural resources, through "Science with a human face."

The Professional Regulation Commission (PRC) of the Philippine Government awarded him the 2007 Outstanding Professional of the Year Award in the field of Agriculture for displaying professional excellence in both private and public practice in the Philippines and abroad and for his noble advocacy of promoting a global yet equitable program of food security in Asia and sub-Saharan Africa.

In February 2009, he was conferred the Father Jose Burgos Award, Ilocos Sur's most prestigious award, for his outstanding achievement in the field of agriculture. In recognition of his excellent and outstanding contribution to pulses research and development, he was honored with the Indian Society of Pulses Research and Development (ISPRD) Lifetime Achievement Award. In October 2009, UPLD honored him with the Outstanding Alumnus Award. In November 2010, he was conferred the Lifetime Achievement Award by the PCARRD Scholars Association,



Inc, (PSAI). In October 2011, he was conferred the 2011 Agriculture Administrator Award by the Philippine Agri-vironment Educators and Entrepreneurs Inc (PASSAGE).

Since leading ICRISAT, Dr Dar has intensively advocated a Grey to Green Revolution in the dry tropics of Asia and sub-Saharan Africa through “Science with a human face.” In pursuing the Institute’s mission, he has strengthened strategic partnerships with an array of stakeholders – National Agricultural Research Systems (NARS), Agricultural Research Institutes (ARIs), Non-governmental Organizations (NGOs), development agencies and the private sector. These initiatives led to a stronger ICRISAT working for a food-secure semi-arid tropics (SAT).

In April 2010, ICRISAT led by Dr Dar won the CGIAR’s Science Award for Outstanding Partnership together with the World Vegetable Center (AVRDC), for improving the lives of women and children in West Africa. In 2008, it had won for the fifth time the King Baudouin Award (the most prestigious in the CGIAR) along with eight other Centers. This was made possible through its involvement in the Collaborative Research Program for Sustainable Agricultural Production in Central Asia and Caucasus. Earlier in 2004, it had won the award together with CIMMYT, IRRI, IWMI and other national systems in the CIMMYT-led Rice-Wheat Consortium for the Indo-Gangetic Plains. In 2002, the Institute together with ICARDA had bagged the award for developing new chickpea varieties with higher tolerance to drought and heat, and greater resistance to pests and diseases that provide stable and profitable yields. ICRISAT is the only CGIAR Center to have bagged this award five times.

Dr Dar’s astute and decisive leadership was repeatedly manifested in the Institute’s surplus budgets in the year 2000 and from 2003 to 2011. In 2009, a very positive Sixth External Program and Management Review (EPMR) pronounced that “ICRISAT today is a thriving research institute with a unique capacity to address poverty alleviation, food security, and natural resource protection in the semi-arid tropics.”

There were more research outputs and impacts created by the Institute during the last ten years as well, both in Asia and sub-Saharan Africa. The turnaround for the Institute was possible because of Dr Dar’s effective and human-oriented management, big-picture decisions and innovations and the positive attitude and high morale he infused in the staff. He led the Institute in mapping out a new Strategic Plan to 2020, a road map to empowering the poor in the drylands.

As a demonstration of the strong faith in his outstanding leadership, the Governing Board awarded Dr Dar a third five-year term in office, starting 2010.

Dr Dar’s transformational leadership has turned ICRISAT into a forward looking institution, which has been ranked ‘Outstanding’ consecutively in 2006 and 2007 among the CGIAR centers. A man on a mission and a champion of the poor, Dr Dar has made a big difference and continues with conviction his mission of helping alleviate the conditions of the poor people living in the drylands of Asia and sub-Saharan Africa.

Foreword


It gives me great pleasure to write this Foreword to Dr Dar's 2011 speeches and presentations. ICRISAT is now one year into implementing its bold Strategic Plan to 2020 to help ensure integrated market-oriented development for prosperous, food-secure and resilient dryland tropics.

Change is the leitmotif of ICRISAT and the Consultative Group on International Agricultural Research (CGIAR) and the many countries in which they work. ICRISAT has been constantly reinventing itself and directing its research to tackle mounting challenges and major changes occurring in the external environment. To help orient ICRISAT in the changing world, I am pleased to have witnessed the emergence and adoption of a strong Strategic Plan and the start to its systematic implementation in Asia and sub-Saharan Africa. Although, as the Plan reveals, the issues and their solutions are complex, ICRISAT has the single aspirational target of halving poverty, hunger, malnutrition and reducing environmental degradation in the dryland tropics.

The conceptual framework of Inclusive Market-Oriented Development or IMOD spelt out in the Strategic Plan envisages not just the unleashing of the energies of the poor, but also that of the people and agencies that serve the poor with their science.

In striving to become a learning organization, ICRISAT has demonstrated a collective will and commitment to harness novel ideas and channel them towards fulfilling the Institute's goals. This has been possible through buy-in by staff and partners to the critical ideas and change plans. It has involved not only changing what is done but also how it is done. By adopting, owning and practising shared values and a culture of service, ICRISAT and partners strive to help smallholder farmers in the semi-arid tropics map out a prosperous, food-secure and resilient future. ICRISAT also contributes significantly to the reforms and progress being achieved in the CGIAR.

The speeches in this compendium reflect the changes that have taken place in ICRISAT and the stabilizing influence of its leadership in providing decisive directions and support. It is an instructive chronology of how an Institute can build on its past while innovating in its transition into the future.

A portrait of Meryl J. Williams, a woman with short brown hair and glasses, wearing a blue short-sleeved shirt and a black and white patterned scarf. She is smiling and has her hands clasped in front of her. She is wearing a green lanyard with an ICRISAT ID card around her neck. The background is a plain, light color.

Meryl J Williams

Member, ICRISAT Governing Board

IMOD: Innovate • Grow • Prosper •




Dear colleagues,

A very warm welcome to all of you. It is inspiring to see all the energy, experience and expertise in this auditorium today.

To me, and I hope to you, this Annual Research Meeting is very special. We have the chance here to renew and reinvigorate ICRISAT in a major way, capitalizing on the intensive strategic deliberations that we all participated in over the past year. We've also raised the expectations of our stakeholders who participated on a broad scale.

Address, ICRISAT Annual Research Meeting, 24 January 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.



Now is the time to implement our new strategy. We have to walk the talk. We must get this right.

Our strategy, as you know, is about harnessing markets to achieve our four Mission goals: to elevate the poor out of poverty, hunger, malnutrition, and environmental degradation across the dry tropics of the developing world. We call this strategy IMOD for short, that is, Inclusive Market-Oriented Development. We also summarize it in three simple words:

Innovate • Grow • Prosper •

Our role as a research-for-development institution is to Innovate. Better and more diverse crops and crop products, better, more resilient and productive cropping systems, and better policies and partnerships are the kinds of innovations that we have promised to the world. But we cannot develop these in a fragmented way. They have to be part of a unified strategy. The strategy that links them together is IMOD.

The word ‘Grow’ signals that our innovations contribute by helping the poor to grow into new and more productive agricultural livelihoods. ‘Grow’ is a dynamic word. It reflects change from one state to another in steady progress over time. Here we mean that, we do not work simply to ease the pain of the poor. We do not accept poverty as an eternal state.

We want change. We work to help them get *out* of poverty. In IMOD we are saying that we will help the poor move steadily along a path from subsistence farming, to market-oriented farming. So we will look at development differently than we did in the past – we will look at it from the perspective of *dynamic change*.

To deliver on this promise, we must understand deeply how to enable and motivate this kind of growth. We must consider that all too often, the true poor are left out because they lack the resources and empowerment to change by adopting high technology. They are left behind.

Our approach must be deliberately inclusive of those who need us most. Women and children particularly suffer from poverty, hunger, and malnutrition in the tropical drylands. This is especially tragic, because they form the future of the drylands.

They cannot be left behind. IMOD without the “I” would be a hollow victory. We must help the truly poor to participate. And we must not forget the risks. We must ensure that change is accompanied by safety nets and resilience strategies.

If we get it right, our contributions will help the poor to succeed in moving along the IMOD pathway leading to prosperity.

Prosperous families are no longer hungry and malnourished. They have the skills, the tools, the relationships to markets, and the safety nets that enable them to

sustain resilient farms and livelihoods. When the poor achieve this, enabled by ICRISAT and many others, the world will judge that we have done our job right, and have done our job well. We will be strongly appreciated, and the world will support us to expand our impacts further.

Since IMOD is a dynamic strategy of progression from subsistence to market-oriented livelihoods, I think we all realize that we must develop our innovations with a systems perspective in mind. A systems perspective looks at how innovations fit together to make a functioning whole.

To define our systems, we must first identify the targets that we want to reach. By that I mean, we must identify those impacts and outcomes that we believe will deliver the highest payoff towards our Mission goals.

The connection to our Mission is very important. We may be tempted to work on certain topics out of intellectual curiosity, or impact outside of our Mission context, but since we are an applied science organization, our curiosity needs to lead to impacts that we have embraced in our Mission.


Once we've defined those top priority impacts and outcomes, we will be able to clearly describe the systems needed to deliver those. We will also be able to identify the constraints and bottlenecks to that delivery. This is where we must innovate solutions.

Not us alone; but us working with partners who will contribute innovations that lie outside our own expertise. So the systems perspective leads us to identify the partners that we need to achieve our highest priorities. In this way our strategy leads us naturally to identify partnerships with purpose.

Our partnerships with purpose strategy also helps us to focus. We do not build partnerships just for the sake of boasting that we have hundreds of partners. We build partnerships only as needed to better achieve clearly defined priorities leading to our Mission goals. Purposeful capacity-building follows the same logic.

Taken together, all these aspects of IMOD represent a real change in business as usual. In the past, we mainly looked to our own areas of disciplinary training, developed the best innovations that we could... but then left it to others to figure out how to put these diverse innovations





together into an overall package that delivered prosperity for the poor. Too often, it just didn't happen. We underestimated the challenge of moving from innovations, to better-functioning systems in the real world.

Having learned this, we are now committing to broaden and deepen our approach. We will work in teamwork and partnership to understand how the parts fit together into a working whole. We will have a clear idea from the start of how our priority systems work, what obstacles and opportunities we and others will tackle, what we will achieve by when, and how we will fit all the pieces together and share them with the poor.

It's like building an engine – the engine of development will only move if the parts are designed to work with each other, and placed into a real vehicle connected to real wheels that are ready to roll.

Colleagues, I hope these introductory comments have helped to convey to you the importance of our task here, and the great opportunity that we have in front of us. Let us show once again the great team spirit that we all felt as we put our heads together in strategic planning last year. We came up with a rich new IMOD strategy and many exciting ideas.

We agreed to think creatively and innovatively, to be open to change, to take risks, to get out of our comfort zones, to build our capacities and partnerships, and not to just do business as usual. We are committed to stronger teamwork, to a systems perspective, and to cultural change towards a learning organization.

Now is the time to show that we meant what we said. Now is the time to walk that talk. Now is the time to reinvigorate the ICRISAT that we all love. The ICRISAT that is the world's leading institution for applying research to help end poverty, hunger, malnutrition and environmental degradation in the tropical drylands.

The whole world cares about our Mission as much as we do, and counts on us to deliver on our promise. We are all servants here, and it is our privilege to serve this great Mission on behalf of the world.

Will Team ICRISAT deliver? I believe Team ICRISAT will, because I know all of you. I know how strongly you share these beliefs.

Thank you, and I wish all of us the very best of success.

Partnerships the key to innovations in agricultural biotechnology




Mr A Raja, MLA, Tamil Nadu; Dr P Rama Mohana Rao, Agricultural Production Commissioner and Principal Secretary; Dr P Murugesu Boopathi, Vice Chancellor, Tamil Nadu Agricultural University; Dr Swapan K Dutta, DDG, ICAR; Dr Rajan Natarajan, President, MIBRT, USA; Mr Elisha Pulivarti, MIBRT, USA; dignitaries, ladies and gentlemen, good morning!

I would like to thank the organizers of this Global Summit on AgBio Innovations for inviting me to speak here today.

The world's population is projected to reach more than 9 billion in

Special address, Inaugural of AgBio '2011, Global Summit on AgBio Innovations, 31 January 2011, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.



2050. This will require a 70-100% increase in food production to maintain the same dietary standard we have today. Without this production increase, more than one billion severely undernourished people will be living near starvation. Such an alarming scenario should serve as a wake-up call to enhance efforts to use modern science to feed the poor.

It has never been more compelling to prepare ourselves for a rising perfect storm – a confluence of the adverse effects of climate change, desertification, and food, energy and population crises. To succeed in this, science's innovation potential to boost economic and social development must be exploited, for which we need to integrate the best of conventional crop improvement technologies with the best of crop biotechnology applications.


Five priority actions are critical for improving the chances of science innovations in agricultural biotechnology for sustainable growth and development. These include empowering the scientists working on science innovation for development; strengthening science innovation systems through north-south and south-south research collaboration; making accessible new technologies for development; gearing research design and delivery towards impact; and lastly, helping policymakers understand how biotechnology can help reduce poverty.

ICRISAT believes that biotechnology can contribute to global food, feed and fiber security; improve health and nutrition; use less external inputs for a more sustainable agriculture and environment; conserve biodiversity; help improve economic and social status; and alleviate poverty in poor countries.

We have pioneered genetic transformation technologies for important legumes including groundnuts, pigeonpea and chickpea for resistance to various biotic and abiotic constraints, and their nutritional enhancement.

Hybrids/varieties developed by ICRISAT have reached increasingly greater numbers of farmers in the semi-arid tropics through private sector partnerships. ICRISAT with its partners has developed hybrid pigeonpea through cytoplasmic male sterility (CMS) system. Protocols and information/analysis systems for the molecular characterization and gene mining of crops, their pests and diseases, and bio-control agents have been similarly developed.

The Agri-Science Park@ICRISAT (now renamed the Agribusiness and Innovation Platform) was set up in 2003 to help achieve the institute's mandate to help poor farmers in the semi-arid tropics through public-private partnerships. Its components include the Agri Innovation and Partnership (AIP) Program, the Agri-Business Incubator (ABI), and the NutriPlus Knowledge (NPK) Center. Through it, ICRISAT has delivered improved research products such as sweet sorghum, groundnut and hybrid pigeonpea technology to farmers and innovative ventures in biofuels, nutraceuticals, agri-clinics and crop biotechnology.



The Hybrid Parents Seed Research Consortium was formed to increase the scope of accessibility to better hybrids of sorghum, pearl millet and pigeonpea. The Agri-Business Incubator has emerged as a champion in incubating several technologies and enterprises, such as the use of sweet sorghum for ethanol production, and is a model for facilitating the creation of competitive agri-business enterprises through technology development and commercialization.

Food security, health and nutrition issues are addressed through NutriPlus Knowledge Center, a platform for R&D and innovation in food processing with focus on cereals, legumes, fruits/vegetables, and medicinal and aromatic plants.

Among the strategic research services that enable high-quality R&D is the recently established ICRISAT-Department of Biotechnology (DBT) Platform for Translational Research on Transgenic Crops (PTTC). The facility will translate transgenic technology and harness its products to meet the needs of agricultural growth and serve as a facility of reference to strengthen national, regional and international linkages in transgenic R&D, exchange of materials and information, as well as support training, consultation and technology commercialization.

These initiatives that have been built on complementarities, have been highly successful in moving technologies off the shelf to vulnerable groups; enabling access to cutting-edge S&T for research with positive impacts, facilitating innovation, and more importantly, leading to pro-poor benefits. ICRISAT's new Strategic Plan to 2020 strongly reiterates its commitment to harnessing complementary and purposeful partnerships. Inclusive Market-Oriented Development or IMOD, is the unifying conceptual framework of our strategic plan, and serves as a dynamic progression from subsistence towards market-oriented agriculture. This will achieve a new level of access to resources, stability, and productivity for poor smallholder farmers.

In conclusion, I would like to reiterate that the dryland challenge of eradicating poverty is possible with innovations in agricultural biotechnology. And we can achieve this through purposeful partnerships. The time to act is now!

Thank you!



Yes we did, and we will deliver!



Dear colleagues and friends, good afternoon!

I have the feeling that something great has happened here over the past two weeks. It feels like a new ICRISAT has been born.

When we started out on January 24th, I put a number of challenges to you. They were big challenges, requiring change from business as usual. What I have observed is that you took up these challenges with full vigor. You put the Institute first, and your own comfort zone second. You trusted in change. You worked with it, rather than against it.

Closing message, ICRISAT Annual Research Meeting, 4 February 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.

I congratulate all of you, because you did the right thing. Change offers new and exciting opportunities for us all. We just have to venture out of our comfort zones and look around carefully, under the bushes and over the walls. We will find treasure where we least expect it.

I'm really looking forward to sharing our progress with our stakeholders. Many of them praised our boldness in our new Strategic Plan, but they still wondered whether we would walk the talk. When they learn about what we accomplished here, I believe that they will conclude that "Yes, they did".

We set aside our own egos. We took the time to listen carefully to each other. We took a disciplined, logical approach to work planning. We began with our four Mission goals – reducing poverty, hunger, malnutrition, and environmental degradation in the dry tropics.


We worked logically back from there, describing the Outcomes, Outputs, and Milestones we would need to achieve in order to reach those goals.

All the way along, we were true to our commitment to use a systems perspective and to work across Programs, not in a disciplinary isolation. We internalized the new IMOD framework, and we used it as a unifying strategy so that our research activities will be complementary and coherent.

We also internalized the need to effectively communicate our work to our stakeholders so that they will continue to support us, and to even strengthen and increase that support.

I introduced to you our tagline for IMOD, to capture its essence in three simple words: Innovate. Grow. Prosper. I now realize that this tagline not only describes IMOD. It also describes this great institution of ours. During these two weeks we have innovated, we have grown, and I am confident that we will now prosper. And it is because of your dedication that this has happened.





Of course, our challenges are far from over. They are just beginning. We've taken a very big first step. But now we must go back to our regions and to our partners and to our research activities and approach them in a fresh way.

Our partners will be interested in learning from what we learned. Please take the time to explain the IMOD framework and systems perspective to them, and listen to their suggestions. We need them alongside us as we travel the road ahead. As social media is beginning to show us, there is strength in numbers and in networks. We get stronger as we strengthen our friends and champions.

As this ARM meeting draws to a close, I want to offer a special thanks to Dave Hoisington for his tireless efforts to put it all together. He really went the extra mile. He made sure that thorough consultation was built into every event on the agenda. And Dave was well served by our Research Committee (RC) team that helped him every step of the way. Every member of our Management Group (MG) contributed in important ways to the success of this event.

There are so many others to thank. It's not easy putting on a two-week intensive event for 160 people. To our Housing & Food Services (H&FS) team, to our Visitors Services, our Security, our Farm, Engineering and Transport Services (FETS), IT, and many others – thank you!

I asked you a question two weeks ago: “Will we deliver?” To my happy surprise, a number of you shouted out “Yes!” At that point, I knew we were going to succeed. And we proved we could! You came from far away, but you brought your ICRISAT spirit with you all the way. From Poverty Killers to Passionates, from IMOD Crazies to Dryland Transformers, we all helped each other with great enthusiasm.

So now, with the experience of two weeks of hard work behind us, as your servant leader, I want to ask you again:

Will we deliver?

Thank you. That's the spirit, the culture and the mindset that will help us reach our dreams for the smallholder farmers and their families in the dryland tropics. This is the very essence of the “Science with a human face” that we do.

With that, I now declare the 2011 Global Annual Research Meeting closed. I wish you a safe and pleasant journey home. May we innovate, grow and prosper as we fulfill our promises to the poor and the hungry of the drylands of Asia and Sub-Saharan Africa.

Thank you and God bless all of you!



Capacity building: A pathway to greater crop productivity



Dr JV Patil, Director, Directorate of Sorghum Research, colleagues, ladies and gentlemen, good morning and welcome to the ICRISAT-DSR Learning Course on Sorghum Hybrid Parents and Hybrids Development and Production.

Sorghum is the fifth most important cereal crop after wheat, paddy, maize and barley, and is cultivated over 44 m ha in 104 countries. Apart from its traditional uses as grain for food and stalk for animal feed, sorghum stalks can be used as feedstock for ethanol production contributing to energy security. A climate-smart crop, it adapts well to new and harsh environments that result from expected climatic changes.

Inaugural remarks, ICRISAT-DSR Learning Course on Sorghum Hybrid Parents and Hybrids Development and Production, 7 February 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.

As you know, crop productivity enhancement hinges on the genetic potential of the cultivar and crop agronomy that is location-specific. In sorghum, genetic aspects include mechanisms that can be manipulated to enhance the effects of heterozygosity ie, heterosis on economic traits. The discovery of the male sterility and restorer system due to the interaction of cytoplasm and nuclear genes has been helping exploit heterosis on a commercial scale in sorghum.


As a result, sorghum hybrids have become popular in countries like India, China, Australia, and the Americas. The power of heterosis is exemplified well in China and America, where the adoption of hybrids has helped increase sorghum productivity nearly 4 to 5 times in farmers' fields.

Productive hybrids call for improved parents. And the work of improving hybrid parents and their production is a specialty area, vastly different from varietal improvement and production. It is in this context that this learner's course assumes considerable importance.

I understand that this course is being attended by nearly 20 participants (7 from the private sector and 13 from the public sector), of which 9 are from India, 4 from Tanzania, 2 each from Ethiopia and the Philippines, and 1 each from Kenya, Mali, and Zimbabwe.

I would like to mention that this international learning course is special to us as it is being implemented jointly by the Directorate of Sorghum Research and ICRISAT, with scientists and resources from both organizations jointly contributing to it. I take this opportunity to thank Dr JV Patil for enthusiastically supporting this endeavor when we proposed it.





More importantly, this course comes at a time when we are implementing ICRISAT's new Strategic Plan to 2020. Our plan is anchored on a conceptual framework of Inclusive Market-Oriented Development or IMOD. Smallholder farmers are constrained by a lack of capital, inputs, technology and services, and access to markets which may act as a barrier for their participation in emerging markets. IMOD enables the poor to connect to markets so that they reap higher rewards that trigger a self-reinforcing cycle of re-investment in raising productivity. This in turn raises incomes even further.

A systems perspective to the plan shall allow us to view the fight against poverty in the dryland tropics as a complex system, to be addressed not just with a single intervention but in consideration of the interdependent components of the whole agriculture value chain. Toward this end, we have identified four strategic thrusts, namely: resilient dryland systems; markets, institutions and policies; grain legumes; and dryland cereals.

Our approach to achieving our mission is to engage in purposeful partnerships to generate innovations as well as by capacity strengthening to contribute to impacts. We want to strongly underline the connection between our purposes and our capacities.

This will be done through learning-by-doing with partners and demand-driven skills, training courses and degree programs. Since our inception, we have trained over 15,000 specialists from 48 countries, including 620 in postgraduate degree programs through partnerships with universities worldwide.

We strongly believe that effective partnership among international agricultural research centers too is the key to mutual success. Today, ICRISAT leads the CGIAR Research Programs (CRPs) on Dryland Cereals and Grain Legumes and is actively involved in five other CRPs.

We believe that ICRISAT's strategic plan and the newly formed consortium of IARCs will effectively contribute to help end poverty, hunger, malnutrition, and contribute to a sustainable environment. This learning course is well positioned to contribute to ICRISAT's mission goals.

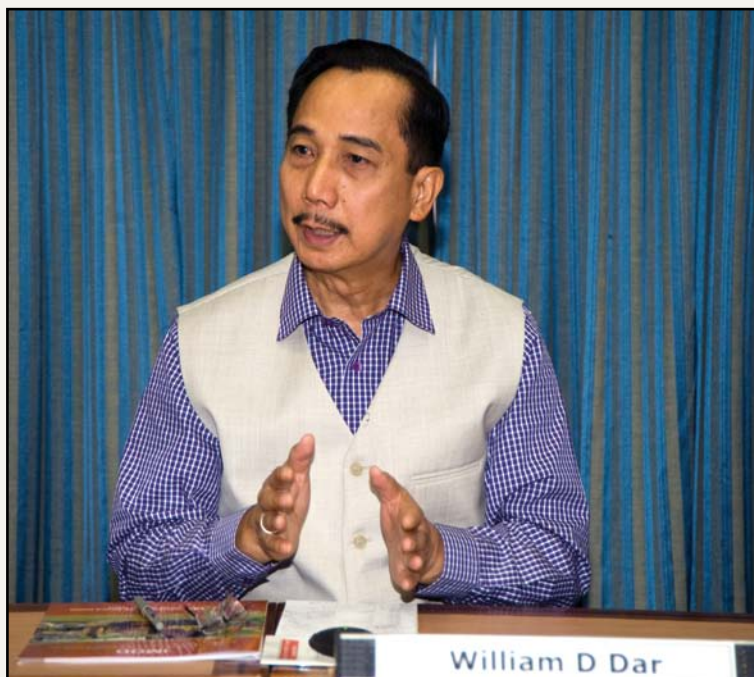
The course is designed to have both theory and hands-on experience in improving sorghum hybrid parents and hybrids and their production. I hope that by the end of the course, you will be well equipped in designing and implementing sorghum hybrid breeding programs suitable for your country and region.

I wish you all productive days ahead and wish the course will be successful in achieving its desired goals.

Thank you!




Legumes the answer to food security in India and Myanmar



Partners from India and Myanmar, colleagues, ladies and gentlemen, good morning and welcome to the IFAD-EC-ICRISAT project on Improving Farmers Livelihoods and Food Security Through Enhanced Legume Productivity in India and Myanmar.

Grain legumes play an important role in enhancing agricultural production, livelihoods and incomes. They are a major source of protein, minerals and vitamins and are mainly grown by smallholder farmers with minimal inputs. In spite of India having 51% (71.4 m ha) of the world's area and 46% of the world's production (57.6 m t) of pulses, it remains a net importer. In the case of Myanmar, of the 23 million ha of agricultural land under

Inaugural address, Launch meeting of the IFAD-EC project on Improving Farmers Livelihoods and Food Security Through Enhanced Legume Productivity in India and Myanmar, 21 February 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.



cultivation, pulses and oilseed legumes are the second most important group of crops – 2.5 million tonnes are produced from 1.75 million hectares.

The area and production of legumes have increased steadily from 0.94 million ha in 1995 to 1.75 million ha in 2009 and area is expected to double by 2015.

Among various food legumes, groundnut, chickpea and pigeonpea are traditionally grown in India and Myanmar for their livelihood and income generation through trade. They are also a source of nutritional security in rural communities. According to the FAO, many families spend about 70% of their income on food; this is bound to increase with recent global increase in food prices.

The per capita availability of legumes in India declined from 22 kg per annum in 1952 to 10 kg per annum in 2003, mainly due to shortage owing to growing demand from a growing population and the slow rate of increase in productivity combined with a high rate of population growth in Asia. Over a third of young children in Myanmar are currently underweight as they lack a balanced diet. Moreover, the relative increase in the price of legumes also affects affordability by the poor.

Yields of these legume crops are still low at about 1.0 t ha⁻¹ against the potential yields realized by researchers (4.0-6.0 t ha⁻¹). This wide yield gap can be bridged by incorporating high-yielding varieties with market preferred traits and appropriate agronomic management.

Legumes play an important role in ensuring soil fertility, crop productivity, and enhancing income through domestic and international markets. However, major constraints to their production in India and Myanmar include lack of better yielding cultivars, good quality of inputs, and biotic and abiotic stresses.

Therefore, increasing legume productivity is one of the few potential strategies available that can be possibly strengthened by legumes research. The current project aims to empower farmers and researchers in India and Myanmar to achieve better livelihoods through enhanced productivity of legume crops.

ICRISAT has been working actively with Myanmar Agriculture Service (MAS) since 1976, and under the Cereals and Legumes Asia Network (CLAN). Based on the germplasm and breeding material provided by ICRISAT, the department of agricultural research (DAR) released 5 varieties of improved chickpea, 5 of pigeonpea and 4 of groundnut, which have been adopted by farmers in several cropping systems, but have yet to reach majority of legume farmers in the country.

Since its inception, ICRISAT has also been working with the Indian NARS on improving the productivity of various crops, including groundnut, chickpea and pigeonpea. This has led to the release of several high-yielding varieties resistant to biotic and abiotic stresses in collaboration with ICAR and other NARS. Crop

improvement and management technologies have been developed, evaluated and shared in a farmer participatory approach in India.


Among the outstanding contributions have been the release of varieties resistant to bud necrosis and foliar disease in groundnut and wilt-resistant pigeonpea and chickpea, with a range maturity groups.

Given that improved varieties are the most cost-effective means of improving crop yield and quality, it is crucial for farmers to know their value and the use of quality seed in achieving higher crop yields. This calls for access to timely and location-specific information and management practices for selected varieties. Healthy seed of improved high-yielding legume varieties well-suited to local agro-ecological conditions and possessing the required tolerance/resistance to prevailing stresses must be locally available to farmers at affordable cost. So should technologies for immediate adoption by farmers.

However, large-scale adoption of these varieties and technologies elude farmers, posing a hurdle to realising potential yields in target areas. Experience gained from this project reveals that seed production of farmer preferred varieties has been initiated on about 10 ha covering three crops in Myanmar and on over 200 ha in India.

Plans are afoot to upscale this to 100 ha in Myanmar and 500 ha in India to meet the requirements of 50,000 farmers during the project period. Apart from all these factors, harnessing markets is crucial. ICRISAT's new strategy to 2020 is anchored on a conceptual framework of Inclusive Market-Oriented Development or IMOD. We believe that smallholder farmers are constrained by a lack of capital, inputs, technology and services, and access to markets which may act as a barrier to their participation in emerging markets.





IMOD enables the poor to connect to markets so that they reap higher rewards that trigger a self-reinforcing cycle of re-investment in raising productivity. This in turn raises incomes even further.

Our approach to achieving our mission is to adopt a systems perspective and engage in purposeful partnerships to generate innovations as well as by capacity strengthening to contribute to impacts. Toward this end, we have identified four strategic thrusts, namely: resilient dryland systems; markets, institutions and policies; grain legumes; and dryland cereals.

Our partnership has shown that farmer-participatory research has been built jointly on the rich knowledge of legume farmers and researchers in developing and assessing new varieties and management practices to suit their social and environments can be fruitful. The direct collaboration between research and IFAD loan projects helped in the rapid identification of useful technologies and their large-scale dissemination to farmers.

Regional collaboration among legume researchers were enhanced during the exchange of breeding materials. We have also learnt that seed production and distribution close to users significantly reduces transaction costs by empowering community-based organizations to engage in seed production. Also, linkages of seed producers to markets and to loan institutions are of prime importance.

Established seed systems and integrated crop management (ICM) programs can provide stability and sustainability in agricultural production through efficient utilization of improved varieties and technologies.

Farm income can be increased with enhanced production and reduced inputs on chemicals. Available options can be fine-tuned through on-farm farmer participatory approaches involving the NARS, NGOs and other stakeholders. I am sure all these steps will help in absorbing shocks such as drought and crop failure to enable resource poor farmers overcome hunger, poverty and malnutrition.

I am sure this project will further contribute to the institutionalization of these collaborative approaches by linking national research program efforts with farmers and farmer organizations that support development projects. As you firm up your work plans, please remember to keep the poor farmer in mind!

Thank you!

Innovation is key to growth




Dr Syed Hasnain, Mr BP Acharya, Dr BS Bajaj, distinguished awardees, honored guests, ladies and gentlemen, a very good afternoon!

I would like to thank the organizing committee of BioAsia 2011 for inviting me to chair the awarding ceremony and do the honours to the recipients of the Federation of Asian Biotech Associations (FABA) Award.

BioAsia as a forum for the global biotechnology business community, has been active since 2004. Assisting biotech and pharmaceutical companies in creating new business partnerships, aiding academic and industrial collaboration and exploring and sharing resources, it has served as a great forum for networking among the fraternity.

**Address, Inaugural ceremony,
presentation of the FABA Award, BioAsia
2011, 21 February 2011, Hyderabad
International Convention Center,
Hyderabad, Andhra Pradesh, India.**



Over these years, the forum has grown from merely being an annual event into a platform that provides support to the biotechnology and life sciences industries.

The Government of Andhra Pradesh has always taken the lead in organizing BioAsia every year in association with FABA, the All India Biotech Association (AIBA) and the University of Hyderabad. We congratulate the organizers and the participants for the commendable efforts that have gone into organizing this event.

This eight edition of BioAsia 2011 will feature three tracks – MediAsia, HealthAsia and AgriAsia – with speakers from across the globe highlighting the opportunities and developments in and challenges to the industry.

BioAsia has always provided a platform for discussing new approaches in the field of biotechnology, integrating innovative developments and converting technologies into industrial products. ICRISAT has always been associated with BioAsia since its inception as one of its active partners.

Today as the world is grappling with issues of food insecurity, malnutrition, and new diseases, there is a greater need for men with vision who can show the way to innovations.

From the date of the first printing press to the current explosion of the World Wide Web and the unravelling of the human genome, the greatest moments in the history of innovation have shown the course that human achievement has taken.

Some inventions proved to be turning points in the way civilization proceeded forward and have had an enduring effect on the world. We have among us today men who have shown the way.

FABA instituted a special award during BioAsia 2010 for personalities who have contributed significantly to the life sciences industry. Today we have two distinguished personalities who will be receiving the FABA Award – Dr Roger L Williams, CEO, United States Pharmacopeia and Dr Davinder S Brar, Chairman, GVK Bio-sciences Pvt Limited. Congratulations gentlemen!

Thank you!

Breeding by design: No longer a dream




Dr Arvind Kapur, Dr SR Rao, Dr Nora Alonso Casajus, Dr Vijayaraghavan, Dr Rajneesh Kumar, ladies and gentlemen, good afternoon!

Present day agriculture faces formidable challenges to provide mankind with an appropriate level of food security. With the world's population projected to reach 9 billion by 2050 and climate change threatening to upset even the best plans of humans, it is critical that the remarkable progress made in plant breeding and improvement thus far be sustained and improved upon. This is so since new crops need to be genetically tailored to maximize resource-capture efficiency, yield and yield stability.

There has been a long history of integrating the latest innovations in biology and genetics to enhance crop improvement.

Most of the traits considered in plant genetic improvement programs are quantitative, ie, they are genetically controlled by many genes together with environmental variables. Hence, "Breeding by design" becomes an ultimate achievement for plant breeders.

**Address, Technical session on
"Breeding by design", BioAsia 2011,
21 February 2011, Hyderabad
International Convention Center,
Hyderabad, Andhra Pradesh, India.**



Modern biotechnological tools offer unprecedented opportunities, from identifying major loci influencing target traits to selecting for plants with the desirable combination of alleles. Just as Darwin and Mendel established the scientific basis for plant breeding and genetics at the beginning of the 20th century, the recent integration of advances in biotechnology, molecular marker applications and transgenic research has created the foundation for “breeding crops by design”.

Changing concepts and molecular approaches today provide opportunities to develop rational and refined breeding strategies to map out all agronomically important traits on the genetic map of any crop. Biotechnological applications with the suffix ‘omics’, such as genomics/metabolomics/proteomics/transcriptomics/transgenomics and phenomics are direct and potentially useful approaches for improving traits which existing germplasm may lack.

Needless to say that current advances in tissue-derived techniques, genetic transformation and MAS, together with advances in powerful new ‘omic’ technologies, offer great potential to improve this situation. Hence, the key to accelerating such efforts is to better integrate the different research disciplines and activities that form core components of modern plant breeding. Molecular breeding and genetic engineering options have positively impacted the plant breeding paradigm.

Also, methods for assessing the allelic variation at these agronomically important loci are now available. This combined knowledge will eventually allow the breeder to combine favorable alleles at all these loci in a controlled manner, leading to superior varieties. Controlled marker-assisted selection strategies can lead to the production of superior varieties within five to ten years.

“Breeding by design” not only involves integration and complementary application of technological tools and the materials to develop superior varieties. Also during this process, an enormous resource of knowledge is generated that should enable breeders to deploy more rational and refined breeding strategies in the near future. While all these modern tools of science are being used, we must take special care to ensure that the poorest benefit from these innovations. The poor must be enabled to participate, rather than be left behind. The engine of growth runs on the innovation, ingenuity and energy of the poor and of those who help them.

This forms the crux of ICRISAT’s strategy to 2020 that lays emphasis on Inclusive Market-Oriented Development or IMOD, so that the poor farmer of the tropical drylands can emerge from subsistence farming to market-oriented agriculture. For example, it has been shown that technologies that enable competitiveness in export markets have increased poor smallholder incomes substantially in a number of locations. Undoubtedly, modern tools and breeding by design will multiply the productivity of crops and consequently the incomes of farmers who grow them. Converting this potential into prosperity for them is the key!

Thank you!

Biodiversity, genomics and climate change: “Science with a human face” perspective



Drs Mohan Rao, Ramesh Aggarwal, Rakesh Mishra, distinguished guests, ladies and gentlemen, good morning! I would like to first thank the organizers of the ADNAT convention for inviting me to speak on a subject that is close to my heart – biodiversity, genomics and climatic change – in relation to agriculture today.

Several crises confront agriculture today. Warming temperatures, droughts, floods, increasing land degradation and desertification, loss of biodiversity, rising food prices, zooming energy demand and population explosion are creating extreme challenges. Their confluence, if unabated, will lead to a ‘perfect storm’.

Will it then be possible to feed the world’s population that is projected to reach 9 billion by the year 2050?

Inaugural address, 15th ADNAT Convention on Genomics and Biodiversity, 23 February 2011, CCMB, Hyderabad, Andhra Pradesh, India.

Will we be able to increase global agricultural production by 70-100% to meet this need?

Plant genetic resources are essential components to meet future global food and nutritional security needs. Crop germplasm diversity contributes to developing improved crop cultivars and hybrids aimed at increasing crop productivity.


About 7,000 plant species have been used as food, but many more species are known to have edible parts and therefore, can be used in future. I'm sure most of us remember how our elders especially prized certain landrace varieties of crops for their special taste or appearance or easy cooking or storage ability or other traits.

However, despite 191 nations pledging to achieve a significant reduction in the rate of biodiversity loss by 2010 at the Convention of Biological Diversity (CBD) in 2002, the rate of loss has increased rather than declined! Efficient management of biodiversity and its conservation and use are the major challenges facing us today.

With advancements in genomics research, in future, genes from many species will be utilized for a variety of purposes. But if the biodiversity is lost, these future possibilities will also disappear.

Several steps are being taken to conserve biodiversity, such as maintaining catalogs of genetic resources and national biological inventories; measures to reduce emission of greenhouse gases and ozone-destroying compounds; effective measures for conservation of biodiversity by including genomics tools; and *in situ* and *ex situ* conservation, among others.





ICRISAT's genebank is helping to conserve five important dryland crops: sorghum, millets, groundnut, pigeonpea and chickpea. It holds more than 119,000 diverse landraces and wild relatives collected in 144 countries. It is held in trust for all of humanity and is now being duplicated in Svalbard, Norway for backup security.

According to the World Development Report 2008, increasing crop failures and livestock deaths due to climate change are already imposing high economic losses and undermining food security in parts of Sub-Saharan Africa and Asia.

The problem arising due to climate change can be dealt mainly through: (a) development and adoption of climate-resilient crop varieties and animal breeds; (b) management of crops, animals and natural resources; and (c) steps to ensure sustained production levels of crops, animals and other natural resources, while providing other vital services for people and the environment.


ICRISAT's climate change 'Hypothesis of Hope' for the semi-arid tropics states that how farming systems cope with current rainfall variation is likely to yield important clues for adapting to future climate change. High yields are still possible under climate change if empowered farmers combine improved practices with climate-adapted crop varieties.

ICRISAT has proven innovations in crop, soil and water management that can help farmers better adapt to climate change. We have developed short-duration chickpea cultivars and short-duration groundnut cultivar ICGV 91114 that escape terminal drought.

We have also developed super-early chickpea and pigeonpea lines that mature in about 65-75 days. ICRISAT and private sector partners have developed pearl millet hybrids 9444 and 86 M 64 that flower and set seed at temperatures as high as 44°C. We have also developed downy mildew-resistant pearl millet hybrid HHB 67 Improved in India; wilt-resistant high-yielding pigeonpea ICEAP 00040 in Tanzania, Malawi and Mozambique; and rosette-resistant groundnuts in Uganda, to name a few.

ICRISAT's new strategy to 2020 with Inclusive Market-Oriented Development or IMOD as its conceptual framework, stands up to these challenges. We believe that the use of genomics and biodiversity will be very critical to improving the livelihoods of poor smallholder farmers in the tropical drylands of Asia and sub-Saharan Africa.

Our strategy views agri-biodiversity as a crucial tool for raising farm incomes while diversifying diets to end malnutrition. Forty two percent of Indian children are malnourished, while Africa has one-third of its children under hidden hunger. By adding value to farming, farmers will have an incentive to preserve and sustain this agro-biodiversity for future generations leading to environmental security.



We are speeding up this type of research. We call this “Science with a human face”.

For instance, leaves of the Moringa and the “Pomme du Sahel” (*Ziziphus Mauritania*) fruit are very rich in vitamins and in strong demand in the parched Sahel zone of Africa. Small-scale drip irrigation there is expanding rapidly as it enables a much wider range of species to be cultivated year-round.

I am sure that the deliberations during this meeting will help the scientific community to develop future research strategies in the area of conserving and harnessing biodiversity for agriculture, human health, and environmental security.

Wishing you all the very best!

Thank you!


Innovation is key to agricultural growth and prosperity



Ladies and gentlemen, international agricultural research has played a key role in expanding food production in the last 50 years. Of the total public expenditure on agricultural research worldwide, 4-5% is represented by the Consultative Group on International Agricultural Research (CGIAR), of which ICRISAT is a member. However, under-investment in agriculture over the past 30 years and high food prices are all combining to sharply increase the level of global food insecurity. It is imperative that at least 1.5% of agricultural GDP is committed to agricultural R&D by developing countries for there to be any signs of impact on the poor and hungry.

Rising temperatures that shorten growing seasons and reduce crop productivity, reduced access to water, greater disease potential and heat stress, shifting precipitation and runoff patterns, altered pest and weed patterns, more frequent and furious floods and droughts, and

**Address, PC Mandal Memorial
Lecture, 28 February 2011, Birsa
Agricultural University, Jharkhand,
India.**



the loss of biodiversity threaten to make agriculture riskier for vulnerable farmers. They multiply the risk of poverty and hunger.

Climate change and a limited resource base add to the longer-term constraints. Given this scenario, and a world population that is projected to reach more than 9 billion in 2050 combined with over one billion severely undernourished people, food production will need to increase by 70-100% to maintain the same dietary standard we have today. Meanwhile, agricultural productivity growth, especially in developing countries, continues to drop and the decline of global food stocks in the last five years has led to very tense cereal markets worldwide.

ICRISAT has an agro-ecological mandate for the semi-arid tropics or tropical drylands of Asia and Sub-Saharan Africa, with primary responsibility for chickpea, pigeonpea, groundnut, sorghum and pearl millet, essential to the diets and livelihoods of the poorest of the poor.

Three hundred million people in the dryland tropics live on less than \$1 a day. Seven hundred million live on less than \$2 a day. These people live in a constant state of hunger and insecurity. Childhood malnutrition is rampant in this region – 42% in Asia and 27% in Sub-Saharan Africa. Battling these scourges in addition to the perfect storm converging on the dryland poor is a major challenge.

ICRISAT believes that the alleviation of the water crisis in the SAT can happen with the management of “blue water” and “green water”. The challenge lies in integrating improved crop varieties, timely planting, fertilization, weed management, conservation agriculture, rainwater harvesting, supplemental irrigation into smallholder farming systems through an adaptive research and extension process.

Our watershed management model has improved the overall condition of natural resources and the livelihoods of people involved and is being scaled up/expanded at several locations in Andhra Pradesh, Madhya Pradesh, Rajasthan and Gujarat. The development of community watersheds in China and India has resulted in increased crop yields (up to 4-fold) and increased incomes by 45% and 77%, respectively.

ICRISAT already has on hand crops that are adapted to heat and high soil temperatures, knowledge and understanding of photoperiod-sensitive flowering, information on genetic variation for transpiration efficiency, short-duration varieties that escape terminal drought and high-yielding and disease-resistant varieties.

Among the broad range of innovations that have made a significant difference in improving agriculture and the livelihoods of the poor, include early-maturing fusarium wilt-resistant varieties of both *desi* and *kabuli* chickpea. Between 1973-74 and 2008-09, they led to an 11-fold increase (974%) in

area, a 45-fold increase (4387%) in production and a 4-fold increase (318%) in productivity of the crop in Andhra Pradesh. Short-duration chickpea cultivars ICC 96029, extra-early ICCV 2 and early-maturing JG 11 and KAK 2 can withstand high temperatures.

Similarly, our extra short-duration pigeonpea cultivar ICPL 88039 that matures 10-12 days earlier than the local cultivar was found best suited for rotation with wheat in the Northwestern plains of India.

ICRISAT's early-maturing drought-tolerant groundnut variety ICGV 91114, cultivated on over 12,000 ha in drought-prone Anantapur and on 20,000 ha in the state of Andhra Pradesh, is replacing TMV 2. Its average pod and haulm yields were 15% and 17% higher respectively than those of TMV 2.

Over 70 pearl millet hybrids cultivated on about 4.5 million ha (50% of pearl millet area in the country) contributed to cultivar diversity and increased the crop's national productivity. HHB 67 Improved developed through marker-assisted breeding in collaboration with Indian partners, has enabled farmers to save \$6.7 M of losses from downy mildew disease.

ICRISAT addresses the problem of land degradation by undertaking sustainable land management strategies such as integration of crops with livestock to generate higher resource use efficiency; diversification of crop and livestock products, with a focus on new fruit trees, dual-purpose legume crops, poultry and small ruminants; raising fertility through microdosing; conservation agriculture; and integration of woody plant management with crop and livestock activities.

Ensuring energy security and dependence on fossil fuels is a major global challenge. ICRISAT's approach is to use biomass sources and approaches that do not compete with, but enhance food security and improve livelihoods of the poor, such as "smart crop" sweet sorghum that produces food as well as fuel. In partnership with Rusni Distilleries and some 791 farmers in Andhra Pradesh, India, ICRISAT



helped to build and operate the world's first commercial bioethanol plant, which began operations in June 2007.


It is estimated that over 815 million households worldwide suffer from micronutrient deficiency. Our main objective is to increase the bioavailability of zinc (Zn) and iron (Fe) micronutrients and beta-carotene in the grains of ICRISAT mandate crops through biotechnological and conventional breeding. The feasibility of producing pearl millet hybrids combining high grain yield and high Fe content is being tested in multilocal trials at ICRISAT using high-Fe seed parents and restorers. Results have shown that even with the exploitation of existing hybrid parents that had not earlier been bred for higher Fe content, the possibilities of developing high-Fe hybrids with grain yield competitive to commercial hybrids are bright.

ICRISAT is developing mycotoxin-tolerant cultivars, particularly groundnut, and appropriate pre- and post-harvest technologies that reduce the risk of food/feed contamination through both conventional plant breeding and biotechnology applications; and the development of low-cost mycotoxin diagnostic tools.

Through participatory research methods, we have developed strategies for seed system development covering informal (seed village system) and formal quality seed production and distribution (including hybrid seed production methodologies) and institutional arrangements for seed certification. Through these initiatives, ICRISAT and its partners have achieved significant breakthroughs in the improvement and production of our mandate crops in India.

Consistent with the innovations paradigm, ICRISAT's portfolio has come to include activities that support private-sector incubation and capacity strengthening, funding from charitable foundations associated with the private sector, and wide-ranging programs to commercialize its technologies through the private sector.





Our Agribusiness and Innovation Platform (AIP) comprising the Innovation & Partnership (IP) Program, the Agri-Business Incubator (ABI) Program, and the NutriPlus Knowledge Program, is a means to commercialize technology to help farmers in the drylands.

ICRISAT's new strategy to 2020 is about harnessing markets to achieve our four Mission goals: to elevate the poor out of poverty, hunger, malnutrition, and environmental degradation across the dry tropics of the developing world, aided by purposeful partnerships. The strategy, anchored on Inclusive Market-Oriented Development or IMOD for short, can be summarized in three simple words: innovate. Grow. Prosper.

IMOD incorporates all the tools mentioned earlier in planning, implementing and evaluating our research programs for optimum impact along the whole dryland agriculture value chain. It includes a systems perspective that looks at how innovations fit together to make a functioning whole. ICRISAT's contribution to IMOD through its Strategic Thrust on Resilient Dryland Systems aims to help the poor navigate the pathway out of poverty by reducing their vulnerability to drought and climate change while increasing diversity and value.

IMOD pays greater attention to women, the largest group of poor and hungry, whose children are the dryland's future and who risk being left behind by markets. It is also about building resilience, the ability to withstand and recover from stress, which in the drylands, includes human, social, physical, natural and financial stresses. Diversification is also critical since it can lead to higher income, better nutrition and greater resilience.

We have defined six developmental outcomes that we believe will help the poor to move along the IMOD path – food sufficiency, intensification, diversification, resilience and two cross-cutting outcomes, namely nutrition & health and women. Significant reductions in poverty and increases in food security in the dryland tropics are possible through this route.

We believe this is the way we can meet our aspirational targets of halving the incidence of poverty in smallholder farming households; halving the incidence of hunger, halving childhood malnutrition; and significantly increasing the resilience of tropical dryland smallholder farming.

The need of the hour is for agri-food system research to focus on using better local crops for food production, reducing postharvest losses, optimizing local processing to improve bioavailability of micronutrients, linking local production and processing to urban consumers by delivering safe, nutritious, and good-quality food, improving processing and storage for food safety, dealing with institutional barriers for access to markets, and making more sustainable global food production systems. We owe it to the poor farmer in the developing world!

Thank you!



Innovation and entrepreneurship: Keys to inclusive agricultural growth



Dr S Ayyappan, Director General, ICAR and Secretary, DARE; Dr Bangali Baboo, National Director, NAIP-ICAR; distinguished guests, ladies and gentlemen, good morning and a warm welcome to ICRISAT and to the NIABI 2011 Global Agri-Business Incubation Conference.

The world is again on the verge of a crisis, if the record rise in global food price for the eighth straight month in February is any indication. The FAO Food Price Index, a measure of basic food prices at the international level, averaged 236 points in February, up by 2.2% from January, which is the highest record in real and nominal terms. Wheat saw a 58% price increase on the Chicago Board of Trade in the past 12 months, while rice had 6.5% price increase.

**Welcome address, NIABI 2011
Global Agri-Business Incubation
Conference, 8 March 2011, ICRISAT-
Patancheru, Andhra Pradesh
502 324, India.**



FAO fears that the cost of grain may continue to rise in the next several months. Also, global cereal prices have increased sharply, with export prices of major grains up at least 70% from February 2010 due to the decline in world cereal production last year.


Economists think the problem could worsen as governments curtail grain exports to increase their own stockpiles. At the heart of the problem is the rising demand for crops.

Rising food costs have prompted riots and political unrest across Egypt and Tunisia. In Canada and Australia, bad weather ruined crops resulting in a major price surge. Russia banned grain exports after its worst drought in 50 years, causing unprecedented food price hike.

The turmoil in oil-producing countries has pushed crude above \$100 a barrel, which is expected to drive corn and wheat prices even higher. At the same time, it is expected to make biofuels produced from crops more competitive while raising the cost of fuel and fertilizer for farmers. Countries across the globe probably spent at least \$1 trillion on food imports in 2010, with the poorest paying as much as 20% more than in 2009.

According to the World Bank, 44 million people have been forced into extreme poverty by food inflation since June. As per the Nomura Food Vulnerability Index which comprises 80 rich and poor nations, among those suffering most from costly food are 25 countries, which include India, China, Philippines, Bangladesh, Nigeria, Kenya and Vietnam. To make matters worse, world grain production in 2010-11 is forecast to drop 1.1% to 2.24 billion metric tons.

The confluence of various factors mentioned above is deemed as the “perfect storm.” This is what ICRISAT has been talking about, the perfect storm that is unsettling lives and livelihoods throughout the world. Whether it is climate change and the shrinking farmholding area that will make it difficult to feed 9 billion people by the year 2050, or the rising cultivation costs and low value for farmer produce that makes agriculture unprofitable and hence unattractive to rural youth, innovative modalities become crucial to reverse this perfect storm.



Just like a snake that sheds its old skin to grow a new one, agriculture too is shedding its old ways and embracing new ones to meet the enormous challenges it faces today. The development of innovative products, processes and concepts by entrepreneurs and their integration into existing agricultural systems is the pathway to true inclusive agricultural growth.

ICRISAT's new Strategic Plan to 2020 strongly reiterates its commitment to harnessing complementary and purposeful partnerships, through Inclusive Market-Oriented Development, which serves as a dynamic progression from subsistence towards market-oriented agriculture. This pathway reduces poverty since markets create demand for a wider diversity of higher-value foodstuffs and agro-industrial products.

This stimulates agro-enterprises that raise rural incomes and create opportunities beyond agriculture. Smallholder farm families have to be empowered and assisted along this development pathway to lead them from pessimism to prosperity.


One of our critical focus areas involves fostering agro-enterprises. We intend to do this by promoting and initiating key approaches such as increased demand for agro-input and outputs, a conducive business environment, and above all, proactive government policies. Our emphasis is on the smallholder farmer in the dryland tropics. He must be a key partner in agri-business ventures. For this we need to expose more people to the experiential learning process that will tap into the innate entrepreneurial spirit that exists in the agricultural community.

Modernizing the agro-food system can be a strong engine for direct and indirect growth and poverty reduction in the drylands. It is all about shared challenges, technology exchange, and improved opportunities for communication and collaboration.

At ICRISAT, this seed was sown in 2003, with the setting up of the Agri-Science Park@ICRISAT (now known as the Agribusiness and Innovation Platform) where inclusive growth and development strategy are key. The Agribusiness and Innovation Platform (AIP) helps achieve the institute's mandate to help poor farmers in the semi-arid tropics through public-private partnerships.

The Agri-Business Incubation (ABI) Program, one of its components, has emerged as a champion in nurturing and incubating several technologies and enterprises, and is a model for facilitating the creation of competitive agri-business enterprises through technology development and commercialization.

This is done through a dual mode. The service strategy involves seed, biofuel, farm innovation and agri-biotech ventures, while its outreach strategy involves partnering with institutes/organizations globally. This dual mode promotes agri-business ventures and enhances technology commercialization through co-business incubation.



ICRISAT, through ABI, has established a Network of Indian Agri-Business Incubators (NIABI), with the support of the National Agriculture Innovation Program (NAIP) of the Indian Council of Agricultural Research (ICAR). NAIP is funding Business Planning & Development (BPDs) units or business incubators to support entrepreneurs in agri-business through commercialization of technologies.

By helping nurture innovations and entrepreneurship in the field of agriculture, ABI contributes to the realization of ICRISAT's mission of eliminating poverty and improving livelihoods in the dryland tropics. To date, ABI has commercialized 44 technologies, supported 180 business ventures, mobilized \$18 million investment for ventures, generated direct employment for 832 individuals, introduced 82 products in the market, and overall benefitted 500,000 farmers.

Incubators are important for agricultural and industrial agribusiness sectors where technology has to be a precursor for improving the economic, social and environmental conditions of rural communities. This conference is unique in that it will cover every aspect of agri-business incubation. Starting with the large array of opportunities available to startup ventures, we will go on to discuss seeding incubators for impact, social entrepreneurship, incubator funding issues for research organizations and startups, and how incubators have helped research institutes to effectively enable lab-to-land delivery. Agri-business specialists will also share valuable learning during the investors-startup forum.

In recognition of Women's Day, as well as of the great contribution of women in promoting rural development and entrepreneurship in agriculture, we have a session devoted exclusively to women.

By the end of this conference, you would have been wiser about how agri-businesses can provide an impetus towards shifting agriculture from subsistence to market-oriented mode so that access to farm inputs, market, technology, finance and related services is improved.

Ushering in an evergreen revolution through agri-business is a reality. Let this be the dawn of a new generation of agricultural entrepreneurs. It is the development of innovative products, processes and concepts by entrepreneurs and their integration into existing agricultural systems that will lead to true economic development.

Thank you!

Collective action critical to successful value chain innovations



Mr RK Goyal, partners from DSR, ILRI, SVVU, IICT, CRIDA, and Rusni Distilleries, and colleagues at ICRISAT, good morning and welcome to the Annual Progress Review and Work Plan Meeting of the ICRISAT-ICAR-NAIP project on Sweet Sorghum Ethanol Value Chain.

Last month saw a troubling and record rise in global food prices that threatens to continue in the next several months. Prices surged as bad weather significantly damaged crops from Canada to Australia. At the same time, we have witnessed the turmoil in oil-producing countries including Libya, pushing crude above \$100 a barrel, which may drive corn and wheat prices even higher. As a result, smallholder farmers, whose livelihoods depend not only on

Address, Annual Progress Review and Work Plan Meeting of the ICRISAT-ICAR-NAIP Project on Sweet Sorghum Ethanol Value Chain, 11 March 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.



crop productivity but also on the market value of their produce, have become increasingly vulnerable.

Value chain innovations are crucial in harnessing the power of markets to speed up productivity growth and ensure food security. Scaling-up and developing these institutions are possible through appropriate policies and regulations.

Agricultural value chains can succeed and be sustainable with proper coordination and forward and backward linkages from the production sector to the processing sector, and finally to the end-user.

ICRISAT has been spearheading projects that focus on market linkages/value chains. For instance, we had a project that involved organizing small-scale sorghum and pearl millet farmers into Farmers' Associations, who were then linked to industrial end-users as well as to formal credit and input sources. The Farmers' Association representatives were able to directly negotiate with the end-users and sell their produce in bulk at a higher price.


ICRISAT has also been promoting 'smart crop' sweet sorghum with multi-product potential as a viable crop for bioethanol production. Ethanol can be produced from the stalk, while the grain can be retained for food use and the stillage used as livestock feed or as fuel.

The project on "Value Chain Model for Bio-ethanol Production from Sweet Sorghum in Rainfed Areas through Collective Action and Partnership" under review is primarily intended to explore the possibilities of sweet sorghum use as feedstock in ethanol production (without affecting grain production) and to help farmers find a market for the green sweet stalks in addition to grain.

The project's uniqueness lies in its evaluation of the effectiveness of innovations such as the holistic systems approach encompassing seed to tank; the use of the whole plant for processing and value addition; a research-mediated value chain; unique partnership among researchers, private sector entrepreneurs and farmers; and consortium, collective action, convergence and capacity building.

I understand that partners in this project comprise of the public sector, an international organization, a university, and a private sector distillery, apart from ICRISAT. Some of the important issues that you all should be addressing are: how to increase the feedstock supply window, increase juice, syrup and ethanol yields per hectare; and increasing the shelf life of the juice.

Two value chains have so far been developed: the centralized value chain model and the decentralized one. I understand that work under the centralized model (Rusni Distillery) has been hampered by lack of government support in terms of fair price for ethanol from sweet sorghum, as well as lack of harmony among private partners.



This project has been ongoing for over three years now. I notice that the situation is pretty much under control in the decentralized crushing unit model in terms of productivity enhancement in the field through improved cultivar and agronomic practices, improved juice and syrup recovery, enlarged window for feedstock supply, increased juice shelf life, etc.

The task now is for you to assess the progress made so far, devise ways to fill the gap between what has been achieved and further realizing potential, as well as document the results and experiences. Hence, I urge each one of our partners to devise work plans and to address these issues. As a spin off, I am sure there will be additional information on the production and marketability of alternative products from juice and syrup.

Before I conclude, I wish to inform our partners of the new ICRISAT Strategic Plan to 2020. Its implementation is anchored on IMOD (Inclusive Market-Oriented Development). We believe that smallholder farmers are constrained by a lack of capital, inputs, technology and services, and access to markets which may act as barriers to their participation in emerging markets.

IMOD enables the poor to connect to markets so that they can reap higher rewards, which will trigger a self-reinforcing cycle of re-investment in raising productivity. This in turn raises incomes even further.

A systems perspective to the plan and purposeful partnerships allow us to view the fight against poverty in the dryland tropics as a complex system, to be addressed not just with a single intervention but in consideration of the interdependent components of the whole agriculture value chain.

I am sure that by the end of the workshop, you will be able to design meaningful work plans to contribute to the delivery of outputs to the end-users. I wish you all a productive and rewarding deliberation!

Thank you!



Fueling pulse productivity through genomics



Padmashree Prof E A Siddiq and colleagues from ICRISAT, good morning and welcome to the Launch meeting of the project on Center of Excellence in Genomics Phase-II: Translating Genomics Research for Pulse Improvement funded by the Department of Biotechnology (DBT), Government of India.

Grain legumes play a major role in reducing malnutrition of the 2 billion malnourished people in the world today. Grain legumes are currently grown on about 195 million ha globally, mostly in developing countries where majority of the poor and malnourished people live.

There is an unmet need for grain legumes as demand exceeds current production. This demand is expected to grow by 1% per year through

Inaugural address, Launch meeting of the project on Center of Excellence in Genomics (CEG Phase-II): Translating Genomics Research for Pulse Improvement, 16 March 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.

2020. Meeting this demand will require increasing total production through both productivity increase and tapping potential new niches for cultivation.

Increasing grain legume production, trade and consumption would help reduce food and nutrition insecurity, improve livelihoods of resource-poor farmers, and ensure availability and affordability of grain legumes to poor rural and urban consumers.

However, the agricultural path is currently faced with various challenges – warming temperatures, droughts, floods, increasing land degradation, loss of biodiversity, rising food prices, zooming energy demand and population explosion – and their convergence, if unabated, will lead to what is now dubbed as a ‘perfect storm’.


Climate change is likely to affect traditional areas where grain legumes are grown. Most tropical countries are likely to lose up to 50% crop yields (productivity) in some areas. This will lead to grain legumes being grown in areas that are likely to produce lower yields. Hence, there is an urgent need to develop cultivars that are adapted to warmer temperatures.

These challenges can be met with high yields, more resilient cultivars and better management practices. New science and strategic partnerships improve the chances of finding solutions to these challenges.

ICRISAT’s strategy to 2020 is about harnessing markets to achieve our four mission goals: to elevate the poor out of poverty, hunger, malnutrition and environmental degradation across the dry tropics of the developing world, aided by purposeful partnerships. The strategy is called Inclusive Market-Oriented Development or IMOD.

We have defined six developmental outcomes that we believe will help the poor move along the IMOD path – food sufficiency, intensification, diversification, resilience and two cross-cutting outcomes, namely, nutrition & health and empowering women. Significant reductions in poverty and increases in food security in the dryland tropics are possible through this route.





In this context, modern science tools like genomics and transgenic technology are very important to accelerate crop improvement. ICRISAT is well-placed to use these technologies with strong support from the Government of India. For instance, PTTC was established with support from DBT to strengthen and transfer transgenic technology research in India.

DBT has sanctioned the second phase of the Center of Excellence in Genomics from January 2011, after completion of four years of Phase I.

I take this opportunity to acknowledge the strong support and guidance of Professor EA Siddiq who is an old friend of ICRISAT and Chair of the Center of Excellence programme of DBT, Government of India. A champion of Indian agriculture, his services to this country were duly recognized by the Government of India, conferring on him the Padmashree this year. Please join me in congratulating and thanking him.

The last four years have witnessed the development of significant genomic resources of leading grain legume crops of India and of its mandate crops. Orphan legume crops are now genomic resource-rich crops. Molecular breeding in legumes has become a reality, just like in chickpea.

I understand that as a result of the Tropical Legume I project of the Bill & Melinda Gates Foundation and Generation Challenge Programme, molecular breeding for drought tolerance has been initiated in chickpea.

Phase II of the CEG will undertake similar activities in the area of molecular breeding in chickpea and molecular mapping in pigeonpea. This activity will be in collaboration with our NARS and partners like IIPR, IARI and ANGRAU.

In addition, the established infrastructure for marker genotyping platform will be extended and SNP genotyping platform will also be established in Phase II. As well, genotyping facilities will be available for all crops, not just for ICRISAT's mandate crops.

Another important milestone of Phase I of CEG was the training imparted to 200 scientists – 161 from India and 39 from the developing countries of Africa and Asia. With the commencement of Phase II, we will add 50-60 trained scientists in this group.

We hope that with the help and support of colleagues like Prof Siddiq, as well as NARS partners like IIPR, IARI, ANGRAU and colleagues from ICRISAT, we are confident that CEG Phase II will be more successful.

Wishing you the very best in your deliberations!

Thank you!




Information system the crux of knowledge-intensive crop research



Dr Jean-Marcel Ribaut, Director, Generation Challenge Program (GCP); Dr Warwick Easdown, The World Vegetable Center (AVRDC); participants from CGIAR centers and national agricultural research systems; ICRISAT colleagues; ladies and gentlemen, good morning! Welcome to the International Crop Information System (ICIS) Developers' Workshop being jointly conducted by ICRISAT, AVRDC and GCP and sponsored by the Australian Centre for International Agricultural Research (ACIAR).

Agriculture, particularly in the developing world, faces unprecedented challenges. Rising and volatile food prices, political and economic instability, particularly in major oil-producing countries, poor agricultural productivity, and

Message, International Crop Information System (ICIS) Developers' Workshop, 28 March 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.



increasing pressure on natural resources have emerged as severe threats to the world's poor and hungry. In the coming decades, climate change and variability will exacerbate these threats.

Yet, with new challenges come new opportunities. Advances in science and technology, together with a changing institutional context in global agricultural research, are what will give us insights on how to shape our program directions to help increase food output by 70-100% between now and 2050 as the world population swells to 9 billion.

Progress in bioscience and information and communications technology is particularly promising. Another opportunity is the shaping of a unified system working together to pursue shared goals. Research priorities and activities of CG centers, advanced research institutions, and national agricultural research systems worldwide are now guided by common development outcomes.

This is the underlying principle behind the International Crop Information System. We at ICRISAT are honored to be hosting this workshop as a fitting example of joining forces and coming together to make a stronger impact in achieving development goals such as food and nutritional security and poverty reduction.


At ICRISAT, despite our successes as a premier international agricultural research institute, we are compelled to intensify our efforts at making available to smallholder farmers in the dryland tropics benefits that will enable them to grow their way out of poverty.

Advances in scientific methodologies and technologies will help us address these challenges. They could be in areas like biotechnology, geospatial sciences, modelling, and information and communication technology.

ICRISAT's new strategy to 2020 is anchored on a conceptual framework of Inclusive Market-Oriented Development or IMOD. We believe that smallholder farmers are constrained by a lack of capital, inputs, technology and services, and access to markets which may act as a barrier to their participation in emerging markets.

IMOD shall enable the poor to connect to markets so that they reap higher rewards to trigger a self-reinforcing cycle of re-investment in raising productivity, in turn raising incomes.

We have adopted a systems perspective and are engaged in purposeful partnerships to generate innovations as well as capacity strengthening to create better development impacts. Our four strategic thrusts include resilient dryland systems; markets, institutions and policies; grain legumes; and dryland cereals. One critical focus area that cuts across these thrusts is a modern breeding platform which integrates genetic, genomic and phenotypic information.



We believe that ICIS as a database system providing integrated management of global information on crop improvement and management for individual crops and for farming systems, will be an integral part of our thrusts to realize our new strategy to 2020. By working together with partners in this endeavor, we are more confident of developing more knowledge-intensive crop research efforts.

Digital technology applied through biostatistics and bioinformatics holds great potential to accelerate crop improvement. At ICRISAT, we aim to strengthen past techniques by building a seamless connection from gene to genome to phenotype utilizing high-throughput, genomic map-based and marker-assisted selection and related techniques, through a modern and integrated breeding platform supported by modern data management systems.

We will therefore strive to implement an integrated data management system that will manage genetic resource information, breeding logistics, genealogy, genomic and phenotypic data. Electronic data capture using handheld devices will be initiated to facilitate efficient and high quality data capture, storage and analysis.

More than 30 participants from Australia, Benin Republic, Canada, India, Mexico, Italy, Nigeria, the Philippines, including 6 CG centers and 3 partner institutes are attending this workshop which will review the progress and plan to further enhance the system to benefit the global plant breeding community.

There is no doubt that the key to overcoming the challenges and exploiting the opportunities of the new global agricultural environment is to integrate research priorities and activities into unified programs driven by their potential impact on development, avoiding the fragmentation and duplication of the past. This is what makes ICIS vital to the future of agriculture.

I am sure you will have lots of opportunities in this workshop to share novel ideas and new ways of enhancing data management to benefit your institutions, and ultimately the poor that we all serve. I wish you fruitful deliberations ahead.

Thank you!



Leading the path to sustainable and inclusive agricultural growth




On behalf of the International Crops Research Institute for the Semi-Arid Tropics, I extend my warmest greetings to the Pampanga Agricultural College (PAC) on the occasion of your 30th Commencement Exercises.

First of all, my most sincere thanks to all PAC officials, faculty and staff, particularly to President Jun Soriano, for awarding me this Doctor of Humanities – *Honoris Causa*. I am pleased and honored to receive this recognition, as it will give me inspiration to work harder than ever to impact into the lives of smallholder farmers in the developing countries of Africa and Asia to include the Philippines.

Secondly, I thank all our friends, parents and guests, and most of all, the very reason for our presence here

Commencement address, 12 April 2011, Pampanga Agricultural College 30th Commencement exercises, Pampanga Agricultural College, Philippines.



today – members of PAC class of 2011. Knowing that I will be addressing graduating students from this prestigious agricultural college helped me tremendously in figuring out how I can best stand up and speak out on the issues that matter not only to you but to the future of agriculture in this country as well. Looking at the potential roles you will play in shaping Philippine agriculture – I see more promise of a sustainable and inclusive agricultural growth ahead.

Global challenges and food security

Global agriculture is now facing a convergence of pressures – climate change, land degradation, loss of biodiversity, food crisis, energy crisis, population explosion – called the “perfect storm”. The smallholder farmers are the most vulnerable to the storm; they have the least resources to cushion these shocks. We believe that to reduce the vulnerability of the smallholder farmers to this storm, we must create a sustainable, inclusive, resilient, profitable and healthy agricultural sector.

Particular to the Philippines, food security will continue to remain a key concern. A fight against food insecurity is also a fight against poverty, especially in the rural areas where most of the poor live and depend on agriculture and rural off-farm activities for a living. Hence, a more rapid economic development in the rural poor areas of our country must be pursued to eliminate the root cause of food insecurity – which is poverty.

Right now, we believe that developing countries must, more than anything else, give priority to boosting the agriculture sector in the years ahead. Such an approach will not only increase the output of food and non-food crops but, as a result, reduce poverty as well. The rural poor who produce the bulk of basic commodities are the most deprived of such commodities. The challenge, therefore, is for agricultural growth to be sustainable and inclusive in order to benefit the vulnerable and resource-poor sectors of the society.

Evolving role of SCUs

Today, state colleges and universities (SCUs) like PAC face tremendous challenges as well as opportunities in addressing poverty and food security issues amid the new global agricultural environment. In these extraordinary times, the role of SCUs is now continuously evolving, as they tackle the task of leading the path to sustainable and inclusive growth.

As a premier agricultural state college in the Central Luzon region, PAC’s contribution in addressing the agricultural development needs in this part of the country has been very significant. The College, with its focus on Instruction, Research and Development (R&D), Extension-Training and Production, is highly recognized as a center of excellence for development in agriculture, science and industrial technology, and comprehensive education and training for global competitiveness.

Likewise, PAC is continuously undertaking agricultural research, production and extension-training activities aimed at enhancing the quality of higher education and countryside development. Equally commendable is the promotion of excellence in education and its products for improved agricultural and rural development in the entire Central Luzon region.

PAC has indeed provided a stimulating environment for scientific and technological advances to flourish in this part of the country, balanced by a commitment to bring science-based information and technology to the awareness and reach of potential users, particularly the resource-poor farmers.

Hence, I commend PAC not only for its high standard of education but also for leading the youth of this region to embrace the mission of shaping the future of our agriculture. All these years, you have produced marketable graduates who have distinguished themselves. Until today, the university continues to instill the value of academic excellence and hard work among its students.

Agriculture is central to the economy of Central Luzon. Yet, despite the region's competitive advantage and the efforts of various stakeholders to boost growth in agri-based industries, much still needs to be done to bring about major improvements in the lives of small-scale producers and food-insecure farmers, and to help reduce hunger and vulnerability, especially in the rural areas. This is both a challenge and an opportunity for the University itself and for you – the graduates.



We now encourage PAC even more to emerge as a dynamic academic institution, not only in teaching but in mainstreaming R&D interventions necessary to win the fight against food insecurity and poverty in this country.

ICRISAT's IMOD strategy

Allow me then to offer some advice based on my experience with ICRISAT which is headquartered in India.

At ICRISAT, our strategy focuses on helping the farming poor to harness markets to increase their food supplies and incomes. We call this strategy IMOD – for Inclusive Market-Oriented Development. I want to briefly introduce this strategy and show how this approach may be incorporated in the country's agricultural policy, as well as for SCUs like PAC to consider in scaling up their roles and leading the path to sustainable and inclusive agricultural growth.

IMOD is an inclusive (broad-based) strategy that puts smallholder farmers into the mainstream to participate and reap the benefits of development. This inclusive strategy enables the poor, particularly women and children, to participate, rather than be sidelined, in the development process. ICRISAT implements research programs in ways that benefit smallholder farmers enabling them and their families to go beyond subsistence farming to produce surpluses that can be stored and sold to markets, paving the way for prosperity in the drylands. Surplus produce, which is stored as food, serves as a buffer in times of hunger. Income from marketed



produce enable farm families to purchase more food when needed, including inputs such as seeds, fertilizer, labor, tools, livestock, insurance and education. These will further raise farm productivity, kicking off a series of investments that bring about economic growth. As this is sustained, it creates a self-reinforcing pathway to prosperity.


To achieve inclusive agricultural growth, first we have to reduce the vulnerability of smallholders by strengthening their resilience and livelihoods. IMOD builds on three powerful principles: markets can provide the cash that the poor desperately need to break out of the poverty-hunger trap; social and technical innovations can radically increase farmers' rewards from market participation; and innovations have to be specially tailored to the conditions of the poor.

Here in the Philippines, we must invest on research for development to generate products and innovations that help provide the poor with goods and services they need to participate in IMOD. We must design our research in ways that especially benefit women and children, as well as other disadvantaged members of smallholder households, such as the landless, marginalized communities, unemployed youth and the elderly.

We must generate scientific and technological innovations to reduce vulnerability to drought and climate change while increasing crop diversity and value; harness development pathways for inclusive prosperity; raise and secure productivity for health, income and sustainability; and increase productivity to help end hunger and food insecurity.

Our agricultural policy must target such development outcomes as food sufficiency for all crops, intensification, diversification, resilience, health and nutrition, and women empowerment.





If we can incorporate the above socioeconomic process in shaping the future of Philippine agriculture, we are bound for long-term growth and prosperity.

We in ICRISAT define our core value as “Science with a human face”, indicating our commitment to put people’s welfare first when setting our priorities.

I believe that PAC is treading the same path, of harnessing “Education with a human face,” incorporating socioeconomic dimensions in the academe, particularly to contribute in shaping a sustainable and inclusive Philippine agriculture, and in fighting poverty and food insecurity in the country.

We know that in a developing country like ours, almost a third of the population is poor and hungry. Added to this is the massive environmental degradation that is happening all over the archipelago. If today we are struggling to feed more than 90 million people, as we are still importing much of the food items that we need, what and how can we contribute to feed the almost 150 million Filipino people by 2050?

As you face a new and different world that brings both great promise and great peril, you won’t find the answers from your professors anymore.

You’ll find them by joining the ranks of dedicated professionals who will serve our poor people and help turn the Philippines around. You’ll find them by contemplating on the future of your country and countrymen, by striving to be pioneers and treading the unbeaten path rather than taking the trodden, easy and quicker path. As scholars and professionals, you need to be a part of that change to make a big difference, working with the government, with the private sector, and with the civil society to contribute to the attainment of a sustainable and resilient agricultural growth.

I believe that if we all commit to the same cause, this country is bound for long-term growth and prosperity.

With that, I once again accept this *Honoris Causa* that you have given me, with a solemn pledge to render nothing less than my best.

I wish the graduating students the very best!

Harnessing biofuels for enhanced smallholder livelihoods



Dr Nguyen Van Bo, President of the Vietnam Academy of Agricultural Sciences (VAAS); Dr Bui Chi Buu, Vice-President of VAAS; Dr Rabindra Nath Roy, IFAD representative; scientists and managers from partner organizations in India, Vietnam, China, Philippines, Columbia and Mali; and invited guests, good morning and welcome to the Third and Final Annual Review Meeting of the IFAD-ICRISAT project on Linking the Poor to Global Markets: Pro-poor Development of Biofuel Supply Chains.

Experts predict that majority of the world's oil fields will reach maximum petroleum extraction capacity in 2020, a state otherwise known as "peak oil". After this point, a reduction in pressure causes the rate of production to enter a state of terminal decline. Some quarters

Inaugural address, Third Annual Review Meeting of the IFAD-ICRISAT project on Linking the Poor to Global Markets: Pro-poor Development of Biofuel Supply Chains, 14 April 2011, Gia Linh Hotel, HCMC, Vietnam.

even claim that the official predictions are misleadingly optimistic and that the world has in fact, already surpassed peak oil.


With a looming energy crisis and climate change at the forefront of everyone's minds, there has never been a better time for alternative energy solutions to shine. Economic, environmental and energy security concerns resulting from excessive reliance on fossil fuels are forcing countries throughout the world to shift to environmentally sustainable alternatives like biofuels. Nations are investing heavily on alternative sustainable sources of bioenergy to increase their energy security and reduce their fossil-fuel carbon emissions. Such shifts also aim to generate employment for the rural poor and regenerate wastelands.

Three years ago, we launched this ICRISAT-IFAD project to seal our commitment to work together to enhance the productivity of three important biofuel crops – sweet sorghum and cassava for bioethanol and jatropha for biodiesel.

Today, we have gathered here to assess the progress made over the last three years, share our experiences and lessons learnt and reorient ourselves to the multi-dimensional, multi-disciplinary strenuous tasks ahead. We also hope to be able to better position ourselves in terms of addressing a range of issues as these new alternative energy solutions evolve.

In ICRISAT, central to our BioPower strategy is the focus on biomass sources and approaches that do not compete with, and in fact that would even enhance food production by attracting greater investments that boost both food and biofuel productivity. A key part of this commitment is making bio-energy opportunities work for the poor.





Sweet sorghum is a leading example of our BioPower strategy. Sweet sorghum produces grain for food and feed and sugary stalks for fodder, fuel and fiber. In the case of cassava, the starch in the roots is used not only as food, but is also processed to produce bioethanol. Both crops are drought resilient and are being cultivated on a large scale by poor farmers in the semi-arid tropics. Jatropha yields non-edible oil that can be transesterified to produce biodiesel and is suitable for cultivation in marginal SAT soils.

We at ICRISAT carry out innovative agricultural research and capacity building for sustainable development with a wide array of partners, as is being done in this project. This project has partners from universities and national programs (both public and private sectors) in Mali, Philippines and India, who are all actively engaged in R&D in sweet sorghum and jatropha. Similarly, CIAT and other partners from Colombia, China and Vietnam are involved in cassava feedstock research and its use in bioethanol production.


We are pleased to note that this project is addressing issues of cultivar improvement, development of best-bet agronomic practices, seed/clone multiplication systems development, input and market linkages, and capacity development to create a win-win situation for farmers and the industry.

We are aware that we have spent considerable efforts in realigning and redrawing the 2010 approved work plans to meet the deliverables of the grant agreement, as well as the recommendations of the project mid-term review committee, comprising of Drs Rabindranath Roy and VP Singh. I am glad to note that Dr Roy is with us today as IFAD representative. In this process, some activities were dropped and some new activities were added with an emphasis to address the key factors influencing crop productivity and linkages with all the stakeholders of the value chains.

Also as per donor's suggestion, sugar beet experiments were conducted in partnership with Syngenta Ltd. Let me just mention that sugar beet, along with sweet sorghum and cassava, contributes to longer feedstock availability in a year for ethanol production.

I am glad that progress has been made in selecting improved progenies especially for the postrainy season and refining feedstock production and supply chain innovations in sweet sorghum and cassava; clonal characterization of jatropha; and standardization of agronomic practices and seed/clonal multiplication systems in cassava as planned. Further, sincere efforts were made in capacity development of grassroot-level TCL staff and farmers and promotion of planned on-farm and on-station experiments with TCL. These efforts clearly gave positive results, such as the following:

- TCL decided to replace the existing cultivars (Urja, JK Recova and Sugar Grace) with ICRISAT cultivars (CSH 22 SS and ICSV 93046) as they were convinced of the superiority of ICRISAT cultivars.

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- The average productivity of sweet sorghum improved from 11.85 t ha⁻¹ in 2008 to 20 t ha⁻¹ in 2010 in TCL target areas (highest productivity recorded was 53 t ha⁻¹).
 - Interventions helped even soybean farmers who have taken up sweet sorghum cultivation.

We strongly believe that most of the deliverables of the grant have been met in all crops. I understand that the private sector partners of the project like Tata Chemicals Ltd, could not attend this meeting due to prior commitments but I am sure that my colleagues will convey the results of this meeting to all the partners who could not attend this gathering.

Finally before I conclude my talk, let me just briefly introduce to our partners ICRISAT's new strategy for 2020, which focuses on helping the farming poor to harness markets to increase their food supplies and incomes. We call this strategy IMOD – for Inclusive Market-Oriented Development.

IMOD is an inclusive (broad-based) strategy that puts smallholder farmers into the mainstream to participate and reap the benefits of development. It is built on three powerful principles: markets can provide the cash that the poor desperately need to break out of the poverty-hunger trap; social and technical innovations can radically increase farmers' rewards from market participation; and innovations have to be specially tailored to the conditions of the poor.

The implementation of our new strategy is also anchored on purposeful partnership and a systems' context platform, as is the case in this project. The emphasis on "Science with a human face", IMOD, purposeful partnership, and a systems' perspective will give ample opportunities to accomplish the mission goals of reducing poverty, hunger, malnutrition and environmental degradation by working with partners.

Lastly, I would like to take this opportunity to thank IFAD for their support towards the research and development of these three important dryland crops that contribute to the livelihoods of poor farmers and the energy resources of developing countries. I also wish to thank the officials and staff of the Vietnam Academy of Agricultural Sciences, the Institute of Agricultural Sciences (IAS), the Nong Lam University, and others for hosting this workshop.

We believe that only by working together as partners, and making long-term commitments and investments in innovation, will energy security no longer be a major concern. Together let us make it possible!

With that, let me thank all of you present here today for your valuable time and for your commitment to share your knowledge and ideas with us to contribute to the success of this meeting.

Have a good day!


Making bio-energy opportunities work for the poor



Dr Patricio S Faylon, Executive Director, PCARRD; Dr Astrid Agostini, FAO; partners from the Sorghum Research Institute (SRI), China and the Marathwada Agricultural University (MAU), India; our partners from the Philippines; and colleagues from ICRISAT, good morning and welcome to the Annual Review and Workplan Meeting of the ICRISAT-CFC-FAO project on Enhanced Livelihood Opportunities of Smallholders in Asia: Linking Smallholder Sweet Sorghum Farmers with the Bioethanol Industry.

According to the FAO, about three billion people – or roughly half of the world's population – rely on unsustainable biomass-based energy sources to meet their basic energy needs for cooking and heating, while 1.6 billion people lack access to electricity.

Inaugural address, Annual Review and Workplan Meeting of the ICRISAT-CFC-FAO project on Enhanced Livelihood Opportunities of Smallholders in Asia: Linking Smallholder Sweet Sorghum Farmers with the Bioethanol Industry, 24 May 2011, PCARRD, Manila, Philippines.



In recent years, bioenergy has drawn attention as a sustainable energy source that may help cope with the rising energy prices, address environmental concerns about greenhouse gas emissions, and offer new income and employment to farmers and rural communities in Asia. With a looming energy crisis and climate change on everyone's mind, alternative energy solutions present a viable alternative.

In ICRISAT, central to our BioPower strategy is the focus on biomass sources and approaches that do not compete with, and in fact that would even enhance food production by attracting greater investments that boost both food and biofuel productivity.

A key part of this commitment is making bio-energy opportunities work for the poor. Sweet sorghum is a leading example of our BioPower strategy. Sweet sorghum produces grain for food and feed and sugary stalks for fodder, fuel and fiber.

We at ICRISAT carry out innovative agricultural research and capacity building for sustainable development with a wide array of partners, as is being done in this project. Today, we have gathered here to assess the project's progress, share our experiences and lessons learnt, and plan for year 2.


I believe we have been successful in our project objectives in India and China. We have identified a cluster of 5 villages in Nankheda and 2 clusters of 10 villages in centralized area (Nanded) in India, as well as a cluster of 8 villages in centralized area (Fuxin city) in China for sweet sorghum cultivation.

Farmers in both countries have been sensitized about the sweet sorghum value chain through 11 village meetings and 16 on-station meetings, where farmer participatory evaluation of cultivars was done.

Towards our objective of developing and establishing pilot-scale centralized and decentralized Public-Private Partnership (PPPs) value chain bioethanol enterprise models, a Decentralized Crushing Unit (DCU) was established and operationalized in Nankheda village on a 0.4-ha area, with a verbal understanding reached with farmers and the DCU to buy stalks at ₹ 600 t⁻¹. Twenty hectares were sown in the cluster villages and 7 hectares harvested, producing 1.5 t of syrup.

Towards building seed production and delivery systems, a hub-and-spokes model was developed for input supply in the centralized area in India. A buy-back model was developed and tested in the DCU area, two models developed for the centralized area, and a contract farming model was developed and tested in China.

As we prepare to develop comprehensive workplans for year 2, we will need to keep in mind the lessons learned from the previous year. During this meeting, you will also be exposed to accounting and progress reporting requirements for the project.



Before I conclude my talk, let me just elucidate on ICRISAT's new strategy for 2020, which focuses on helping the farming poor to harness markets to increase their food supplies and incomes. We call this strategy IMOD – for Inclusive Market-Oriented Development.

IMOD is an inclusive strategy that puts smallholder farmers into the mainstream to participate and reap the benefits of development.

It is built on three powerful principles: markets can provide the cash that the poor desperately need to break out of the poverty-hunger trap; social and technical innovations can radically increase farmers' rewards from market participation; and innovations have to be specially tailored to the conditions of the poor.

The implementation of our new strategy is also anchored on purposeful partnership and a systems' perspective. The emphasis on "Science with a human face" aims to accomplish the mission goals of reducing poverty, hunger, malnutrition and environmental degradation.

Lastly, I would like to take this opportunity to thank CFC and FAO for their support towards this project. My thanks also go to the officials from SRI, TLC and SRI, as well as to PCARRD for helping us organize this activity. We believe that only by working together as partners, and making long-term commitments and investments in innovation, will energy security no longer be a major concern. Together we can make it happen!

With that, let me thank all of you present here today for your valuable time and for your commitment to share your knowledge and ideas with us to contribute to the success of this meeting.

May you have most rewarding deliberations ahead.

Thank you!




Dryland cereals spell HOPE for the poor in South Asia



Ladies and gentlemen! Good morning and welcome to the ICRISAT-HOPE-Dryland Cereals project second annual review and workplan development meeting on sorghum in South Asia.

The OECD-FAO Agricultural Outlook 2010-19 projected coarse grain prices over the next 10 years between 15-40% higher in real terms than their average levels for the period 1997-2006. Interestingly, this prediction came true for sorghum in India this year, when its retail market price recorded a new high (₹22 to 25 per kg for rainy season harvest and ₹35-40 per kg for postrainy season grain). This clearly shows that people are increasingly realizing the value of coarse cereals as nutritious foods, something which we have been advocating for a long time now.

Inaugural address, ICRISAT-HOPE – Sorghum in SA 2010, annual review and 2011 workplan development meeting, 14 June 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.



Together with our partners, we believe that far stronger efforts are urgently needed to address key challenges afflicting the drylands and their agricultural production systems, which are vital to creating a better tomorrow for hundreds of millions of the most vulnerable people in the world. In many places, population pressure and the need for agricultural intensification have brought key dryland cereal production systems under increasing stress. Poverty, food insecurity and environmental degradation in the drylands are clearly exacerbating the situation.

Dryland cereals now have substantial economic value and the demand for these crops is driven by a common set of factors. For example, about 50% of the demand for dryland cereals is related to sustaining livestock (feed and fodder) in integrated crop/livestock systems, while at least 40% of what is produced is consumed directly by the poor as food in various forms. Moreover, a growing portion of dryland crops is being marketed for various industrial uses, such as malting, sweet syrups, ethanol and dairy, which is providing increasing amounts of cash income to smallholder farmers.

Given the above, we are now further intensifying our R&D and advocacy efforts to take dryland cereals to the next level of commercialization to benefit millions of smallholder farmers worldwide. We are anchoring this on our CGIAR Research Program (CRP) on Dryland Cereals, which focuses on postrainy sorghum, micronutrient-rich sorghum and sweet sorghum improvement. As you know, in the past, most of our efforts went into rainy season sorghum improvement. Nowadays, the approach is a total shift of research portfolio in a way that reflects the present needs of smallholder farmers as well as the resource-poor people globally.

For smallholder farmers to be more productive and efficient in their farming operations and manage to make a profit, investment in appropriate research and ensuring farmers' access to new innovations are essential.

Sorghum is an important crop in India in particular and in the semi-arid tropics of the world, in general, for its multipurpose uses. It is the dietary staple of more than 500 million people in more than 30 countries of the SAT. Majority of subsistence farmers who cultivate sorghum are unable to take advantage of its high yield potential. The situation can be rectified by growing varieties/hybrids with improved tolerance to drought and low soil fertility, and resistance to pests and diseases.

This is the first time that ICRISAT and its partners have received substantial funding support to pursue R&D on postrainy season sorghum, which is crucial for food and fodder security in this part of the world.


Hence, I take this opportunity to thank the Bill & Melinda Gates Foundation (BMGF) for its support to the cause of small and marginal farmers in sub-Saharan Africa (SSA) and South Asia (SA). My thanks also go to all our partners in this undertaking for their commitment and support.

This project gives us an opportunity to push proven seed-embedded high-yielding technologies in farmers' fields while developing sound backup material on production intensification methods, and markets for future use.

At this point, let me briefly mention some of the changes that are taking place around us. To overcome the challenges and exploit opportunities surrounding global agricultural research, the CGIAR's reform process is on track, and a new Strategy and Results Framework (SRF) has been approved that defines and addresses global issues in a more focused manner. All research priorities and activities of the CGIAR are now guided by their potential contributions to reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, augmented by partnerships.

ICRISAT strongly believes that poor people will change their futures for the better given an opportunity. We developed a Strategic Plan to 2020 to give us direction to achieve six institutional outcomes – food sufficiency, crop intensification, crop diversification, system resilience, nutrition & health and women empowerment. We are developing two CGIAR Research Programs, one on Dryland Cereals and another on Grain Legumes, to address food, nutrition security and environmental sustainability in partnership with NARS, ARIs, CSOs and the private sector.





To ensure the transition from subsistence farming to commercial agriculture, the conceptual framework of this plan includes Inclusive Market-Oriented Development in addition to yield enhancement and this, ICRISAT will apply in a systems perspective to agricultural research-for-development.

Keeping in view climate change impacts on agricultural production, ICRISAT's Governing Board has laid special emphasis on research on heat tolerance while strengthening its work on drought tolerance.

I am happy that this project is aligned with our own focus on yield improvement in postrainy sorghum in India, where terminal drought stress is a major constraint. In line with ICRISAT's regional research focus, postrainy sorghum improvement will be a major area of the work that needs to be carried forward to ensure greater productivity, from the current 600 kg ha⁻¹ to about 850 kg ha⁻¹, an over 40% increase, as set out in the project target.

Two years of the HOPE project's implementation have gone by. I learnt that scientists from all disciplines from different partner organizations have been diligently involved in fulfilling various objectives of the project.

I was told that in all the 10,000 fields we worked in under this project, in Maharashtra, there has been a considerable increase in sorghum grain and fodder yields in both the years, giving farmers additional incomes.

It is time to take stock of the situation and move forward in our approach to consolidate and sustain these gains in the years ahead. I look forward to your inputs in shaping, sharpening and carrying out our current and future sorghum research agenda.

Let me reiterate that the science we do should have meaning for the poor in the semi-arid tropics, and science and development should go hand in hand to win the war against hunger and poverty. I am confident that the outcomes of your deliberations will speed up this process.

Thank you and have a good day!


From pessimism to possibility: Ushering in a second Green Revolution



Honorable Chief Minister of Andhra Pradesh, Mr N Kiran Kumar Reddy; Honorable Minister for Horticulture and Sericulture, Mr Ramreddy Venkata Reddy; President, Associated Chambers of Commerce & Industry (ASSOCHAM), Mr Dilip Modi; Chairman, Agriculture & Food Security Committee, ASSOCHAM, Mr Anil B Jain; Principal Secretary (Agriculture), Government of Andhra Pradesh, Mr V Nagi Reddy; Secretary General, ASSOCHAM, Mr DS Rawat; ladies and gentlemen, good morning!

First of all, I would like to thank ASSOCHAM of India for inviting me here today to speak on a topic that is uppermost in the minds of everybody – the key challenge of adequately feeding a

Theme address, Summit on Green Revolution-II: Growth Engine for Transformation, 15 June 2011, Hotel Taj Deccan, Hyderabad, Andhra Pradesh, India.



global population of 9 billion by 2050. Though the Green Revolution of the 1960s with its improved crop varieties and intensive farming techniques enhanced food grain production and helped stave off mass starvation in that era, its benefits were not sustained and did not fully trickle down to the small and marginal farmlands of the world.

The past half decade has seen a growing volatility in food prices with severe impacts on the world's poor. Global food prices rose for the eighth straight month in February, warning that unexpected spikes in oil prices could exacerbate an already precarious situation in food markets. It reminds us of the 2007-08 food crisis that prompted riots and political unrest across many countries!

According to the World Bank, 44 million people have been forced into extreme poverty by food inflation since June 2010. As per the 80-country Nomura Food Vulnerability Index, among those suffering most from costly food are 25 countries, which include India, China, Philippines, Bangladesh, Nigeria, Kenya and Vietnam.

Agricultural productivity, especially in developing countries, continues to drop and the decline in global food stocks in the last five years has led to very tense cereal markets worldwide.

Degraded natural resources and climate change are increasingly affecting food production and prices, with the farming community, majority of whom are small and marginal farmers, getting poor returns for their produce at a time when the cost of cultivation has gone up drastically. To further compound food availability, the supply chain infrastructure in many countries has remained poor resulting in greater loss. This is the 'perfect storm' or confluence of various factors that ICRISAT has been talking about, unsettling lives and livelihoods throughout the world.

It is estimated that countries across the globe have probably spent at least \$1 trillion on food imports in 2010, with the poorest paying as much as 20% more than in 2009. At the heart of the problem is the rising demand for crops.

However, the goal for the agricultural sector is no longer simply to maximize productivity but to optimize across a far more complex landscape of production, rural development, environmental, social justice and food consumption outcomes.

Among the agricultural priorities that need to be addressed are climate, water resources and aquatic ecosystems; soil nutrition, erosion and use of fertilizer; and biodiversity, ecosystem services and conservation. Energy, climate change and resilience; crop production systems and technologies; crop genetic improvement; and pest and disease management and livestock are also important. So are issues pertaining to social capital, gender and extension, food supply chains, prices, markets and trade; and consumption patterns and peoples' health and nutrition.

The next Green Revolution or the Evergreen Revolution (as Dr M S Swaminathan calls it) will have to be played out across these agricultural priorities, and in less


hospitable agro-ecosystems such as the drylands. It will have to bring about food and nutritional security to billions of people worldwide but without further damaging the fragile ecosystem. And its long-term success will depend on a strong convergence strategy that brings together civil society and the public and private sectors through mutually beneficial partnerships that ultimately advances the agricultural sector.

At ICRISAT, our way of contributing to the realization of the second Green Revolution is our Strategic Plan to 2020. We developed this plan to give us direction to achieve six institutional outcomes – food sufficiency, crop intensification, crop diversification, system resilience, nutrition and health, and women empowerment. Our plan also strongly reiterates our commitment to harnessing complementary and purposeful partnerships, people-focused agricultural research-for-development, and market-oriented agricultural growth.

We implement agricultural research-for-development in Asia and sub-Saharan Africa with a wide array of global partners, impacting on the semi-arid or dryland tropics where over 644 million poorest of the poor dwell. Along with our partners, we help empower these poor people to overcome poverty, hunger and a degraded environment through better agriculture.

We have adopted Inclusive Market-Oriented Development (IMOD) as our guiding principle to empower smallholder farmers to grow their way out of poverty. IMOD is a dynamic progression from subsistence towards market-oriented agriculture. It starts by increasing the production of staple food crops, converting deficits into surpluses that are sold into markets.





Through this inclusive strategy, we will lead smallholder farm families, particularly women and the youth, from pessimism to prosperity. We are confident that IMOD as a strategy will play a vital role in the path to a second Green Revolution.

We continue to broaden our partnerships beyond simply the biophysical sciences sector. We have to bring in whoever is necessary to achieving the objectives of the crop commodity value chain.

We believe that the development of innovative products, processes and concepts by entrepreneurs and private players and their integration into existing agricultural systems is the pathway to true inclusive agricultural growth. We call on all the developing countries to give the highest priority to agriculture and to increase public investments that will develop smallholder agriculture to achieve greater productivity and profitability.

Together with governments, civil society organizations, the private sector, and partners like ASSOCHAM, we are confident that we can make this second Green Revolution happen.

We owe it to the smallholder farmers and the poor people in the developing world!

Thank you!


Crop biotechnology in the fight against poverty and hunger



Dr Clive James, Chair, International Service for the Acquisition of Agri-biotech Applications (ISAAA); Prof Ang Peng Hwa, Chairman, Asian Media Information and Communication Centre (AMIC); Dr SR Rao, Advisor to the Department of Biotechnology-Government of India (DBT-GOI); distinguished guests, ladies and gentlemen, good morning!

It gives me great pleasure to be here today at this very important and timely event – the media colloquium on Demystifying Crop Biotechnology: Issues and Concepts for the Asian Media jointly organized by AMIC, ICRISAT, DBT-GOI and ISAAA. Biotechnology currently forms a debate that somewhat, transcends science, economics, politics and ethics.

Inaugural address, Media colloquium on Demystifying Crop Biotechnology: Issues and Concepts for the Asian Media, an In-Conference Workshop of the 20th Asian Media Information and Communication Centre Annual Conference, 27 June 2011, Taj Krishna Hotel, Hyderabad, India.



Interestingly, there is a great diversity of opinions on this subject, by those who believe that biotechnology holds great promise in winning the global fight against poverty and hunger, and those voices of dissent who believe otherwise.

There are new and exciting developments in biotechnology that are helping the developing world meet the demands for a safe, sustainable food supply. What we should focus on is to harness ways in which we can do a better job of using this science and convey a better understanding of the benefits that it brings.

I am pleased therefore to be among renowned communicators and media practitioners in Asia who are in a crucial position to make this possible. Understanding and enhancing the role of the media in communicating biotechnology is what will facilitate a flow of information between those who have the knowledge and those who require it to make informed decisions.

Global challenges

Today, the world faces “a perfect storm” of issues that could lead to widespread food shortages and public unrest over the next few decades – climate change, population explosion, energy crisis, food crisis, land degradation, shrinking farm holdings, and loss of biodiversity.

Going by the latest FAO data, the world’s population is projected to reach more than 9 billion in 2050, which will require a 70% increase in food production to maintain the same dietary standard we have today.

The formidable task of increasing crop production will require 30% more water and 50% more energy by the middle of the century – at a time when climate change will start to have serious environmental impacts on the planet, flooding coastal plains, spreading deserts and raising temperatures.

The food price hikes of 2007-2008 that are resurfacing today underscore the fragility of global food security, with recent estimates that nearly a billion people are food insecure.

While the causes are many, the underlying challenge is clear. To meet this food security challenge under constraints of limited agricultural land availability and increased climatic variability, the world will need to support and develop scientific and technological innovations that increase agricultural productivity in a sustainable way while improving the availability of nutritious foods.

The promise of crop biotechnology

Biotechnology offers a powerful tool for crop productivity enhancement, not only in terms of quantity but also in nutritional quality. This not only can save lives but can also help farmers adapt to ensuing climate change, battle against pests and diseases, and in the process generate social, economic and environmental benefits for resource-poor farmers.

Transgenic research in particular is a new front in the battle against hunger and malnutrition, and we at ICRISAT believe that if used properly and with caution, it offers enormous advantages particularly in the pursuit of food security and self-sufficiency.

It can raise crop productivity and quality to achieve sustainable food production; make major food crops more productive, nutritious, and affordable; and effectively utilize genetic diversity to improve crop resistance to pests and diseases and environmental constraints.

Clearly, biotechnology is already helping increase global food security, boosting the amount of grain produced per acre worldwide. From 1996 to 2009, yield gains from biotech varieties of soybeans, corn, cotton and canola totalled 229 million tons (James 2010). This is important because farmable land is limited, yet the demand for grain for food, feed and fiber is growing dramatically.

As of 2010, 15.4 million farmers in 29 countries are planting biotech crops. Ninety-three percent of those farmers are resource-poor farmers in developing countries (James 2010).


In addition to yield and productivity improvements, research is well underway to use biotechnology to improve the nutritional profile of crops that are staples in many developing countries where malnourishment or food security is an issue.

Socially responsible science

As an international agricultural research center, what we do at ICRISAT is a science-based, balanced approach to biotechnology, particularly to transgenic crop research. We adhere to the highest international standards, follow stringent regulations, and conduct research in a socially responsible way. Biotechnology research at ICRISAT is focused on such areas as health and nutrition, resistance to pests and diseases, environmental stresses, and food safety.

To cite a few of our biotech initiatives, efforts are ongoing to develop insect-resistant chickpea and pigeonpea and groundnut resistant to major viruses; and to improve the pro-vitamin A content of groundnut and pigeonpea to enhance the nutritional status of the poor, particularly women and children.





We are following a pipeline approach for product development and commercialization. In the future, the delivery of biotechnology products will be carried out through collaborations with our national agricultural research system partners to ensure that the farmers do not have any restrictions on the use of such products.

In all these, the experiences, concerns, and expectations of the poor, particularly those in the dryland tropics whom we serve, are heard, as well as the views of the scientific and environmental community, farmers, and consumers.

We combine rigorous science-based discipline with a deep sense of care and compassion for the resource-poor people whom we serve. We call this “Science with a human face”.

How are we doing things differently?

Biotechnology is a cutting-edge science, and where appropriate, it can be of great benefit to resource-poor farmers. There is, however, a problem.

Biotechnological research is concentrated in the private sector, and its results are proprietary technologies with an orientation to commercial agriculture. Also, biotechnology is still very much identified with multinational corporations (MNCs).

The worry may be justified: When research priorities are determined by the financial return on investment, the needs of those who have the purchasing power are likely to have higher priority than the poverty eradication needs of small farmers.

The role of public and private sectors

For this reason, international agricultural research along with public research must be strengthened. The public sector must take a proactive role in addressing biotechnology priorities of developing countries through increased resources and supportive policies. A strong public sector involvement is vital in advancing biotechnology applications for food security crops, for resistance to biotic and abiotic production constraints, for nutritional value enhancement, and for commercial markets in developing countries.

Meanwhile, partnership with the private sector in terms of technology development with a commercial or application orientation is what will close the gap between research and technology application.

Our efforts to apply science to the problems of the world’s poorest are characterized by public and private sector interactions. ICRISAT acts as a catalyst, bridge, and scientific contributor, helping advance public and private organizations build a solid foundation for the development of a biotechnology-based agricultural industry through an integration and coordination of manpower, capital and technology resources.

The ICRISAT-DBT Platform for Translational Research on Transgenic Crops (PTTC) is our case in point. The facility will enable a collaborative and coordinated approach for the translation of existing genetic engineering proof of concepts to the development of biotechnology crops. Further product development cycle followed by their commercialization will ensure that the resource-poor farmers are not left out from the benefits from this technology.

PTTC will also serve as a facility of reference to strengthen national, regional and international linkages in transgenic R&D, exchange of materials and information, as well as support training, consultation and technology commercialization. It will also provide an opportunity for public sector research institutes and private sector biotechnology companies to work together and generate research products that are national and international public goods.


Risk assessment and biosafety

The underlying principle in all our initiatives is harnessing the best in agricultural science to fight poverty and hunger. In doing so, we want to be quite sure that we capture the benefits of advanced science and guard against its hazards and risks.

At ICRISAT, we believe that the sustained growth of agricultural biotechnology needs, among other things, science-based regulatory decisions. Since scientific advances are opening new avenues for biotechnology applications, risk assessment and biosafety research are essential inputs in our decision making process.

We will proceed with this revolutionary science with caution, giving utmost importance to introducing biosafety measures from the initial stages of research





and following a precautionary approach during the entire product development approach.

Communicating biotechnology

Scientists and world leaders believe that crop biotechnology holds the key to food security and poverty reduction in the developing world. Yet, public misunderstanding about biotechnology due to lack of science-based information poses a big challenge in harnessing its full potential.

This is where communicators and media practitioners come in. Being the primary source of scientific information, the media plays a crucial role in communicating crop biotechnology. This role should be optimally harnessed to inform, educate and mobilize the public as an enlightened user of crop biotechnology products, and the decision makers to come up with supportive policies.

Whereas some people consider biotechnology as a threat, others see a compelling moral imperative to develop genetically improved crops to combat poverty and ensure food security around the globe.

The public debate may have started off as highly emotional, controversial issues with little awareness or understanding. It is now progressing toward improved consumer understanding, real issues and informed opinions. It will further advance from safety issues to one of consumer choice, as biosafety regulations and labeling concerns are sorted out.

Genetically improved foods need to be developed under adequate regulatory processes with full public understanding. At the same time, an increased understanding and acceptance of research tools that draw on farmers' participation could help target research outputs to particular environmental and socioeconomic niches.

At ICRISAT, we will continue to engage the public through multi-stakeholder dialogues on crop biotechnology toward improved public policy, greater public confidence, stronger support for regulatory decisions, and a more informed public.

Lastly, every day we are constantly faced with the challenge of meeting the food needs of 9 billion people by 2050, with shrinking land and increasingly scarce energy and water resources. It is therefore an ethical imperative for us to keep the technological portfolio open to biotechnology and genetic engineering.

Every minute lost, every decision delayed means more people suffering from poverty and hunger. We should not let this happen. Let's do our part now!

Thank you!

Harnessing innovation & entrepreneurship for inclusive agricultural growth




Innovators, entrepreneurs, agribusiness companies, members of the screening committee, ladies and gentlemen, welcome to ICRISAT!

Today, the world faces “a perfect storm” of issues that could lead to widespread food shortages and public unrest over the next few decades – climate change, population explosion, energy crisis, food crisis, land degradation, shrinking farm holdings, and loss of biodiversity.

According to the World Bank, 44 million people have been forced into extreme poverty by food inflation since June 2010. Going by the latest FAO data, the world's population is projected to reach more than 9 billion in 2050,

Keynote address, ABI Agribusiness Innovation Camp, 29 July 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.



which will require a 70% increase in food production to maintain the same dietary standard we have today.

The past half-decade has seen a growing volatility in food prices with severe impacts on the world's poor. Global food prices rose for the eighth straight month in February, warning that unexpected spikes in oil prices could exacerbate an already precarious situation in food markets.

Agricultural productivity, especially in developing countries, continues to drop, while degraded natural resources and climate change are increasingly affecting food production and prices. The farming community, mostly composed of small and marginal farmers, is the most vulnerable to this situation, getting poor returns for their produce at a time when the cost of cultivation has gone up drastically.

To further compound food availability, the supply chain infrastructure in many countries has remained poor resulting in greater loss. This is the perfect storm or confluence of various factors that ICRISAT has been talking about.

We believe that to reduce the vulnerability of the smallholder farmers to this storm, we must create a sustainable, inclusive, resilient, profitable and healthy agricultural sector.


At ICRISAT, we believe that this path involves stimulating agro-enterprises to raise rural incomes and create opportunities beyond agriculture. Smallholder farm families have to be empowered and assisted along this development pathway to lead them from pessimism to prosperity.

One of our critical focus areas involves fostering agro-enterprises. We do this by promoting and initiating key approaches such as increased demand for agro-input and outputs, a conducive business environment, and above all, proactive government policies.

Our emphasis is on the smallholder farmer in the dryland tropics. He must be a key partner in agri-business ventures. For this we need to expose more people to the experiential learning process that will tap into the innate entrepreneurial spirit that exists in the agricultural community.

Modernizing the agro-food system can be a strong engine for direct and indirect growth and poverty reduction in the drylands. It is all about shared challenges, technology exchange, and improved opportunities for communication and collaboration.

At ICRISAT, this seed was sown in 2003, with the setting up of the Agri-Science Park@ICRISAT (now renamed as the Agribusiness and Innovation Platform) where inclusive growth and development strategy are crucial. The Agribusiness and Innovation Platform or AIP helps achieve the Institute's mandate to help poor farmers in the semi-arid tropics through public-private partnerships.



The Agri-Business Incubation (ABI) Program, one of the components of AIP, has emerged as a champion in nurturing and incubating several technologies and enterprises, and is a model for facilitating the creation of competitive agri-business enterprises through technology development and commercialization.


While the Government can focus on dealing with the macro issues, it is our role to ensure that agriculture remains attractive and a sustainable venture. We need to empower the smallholder farmers to grow their way out of poverty. It is in this framework, that ICRISAT has adopted a new strategic approach known as IMOD or Inclusive Market-Oriented Development. IMOD is a dynamic progression from subsistence towards market-oriented agriculture. Such an approach calls for agriculture to be viewed as a 'venture' rather than a livelihood option. However, every 'venture' has risks associated with it. This is where business incubators play a vital role.

The emergence and advancements in Information and Communication Technology (ICT) have seen many IT-related technology incubators and techno-parks come up across the world. A similar approach is the agribusiness incubator, though the number of such incubators is very low (60) when compared to those engaged with IT and ITES. Incubators help in supporting startups tide over the difficulties in the initial years. Worldwide, it has been noted that with incubation support, the closure rate of startups is only 15-20% while it is 66% without such assistance.

Over the years, ABI-ICRISAT has been in the forefront of promoting agribusiness ventures using technology transfer and incubation support that includes technical and scientific backstopping, aided by training and mentoring support and financial assistance from venture capitalists, banks and other government agencies. ABI-ICRISAT is also the coordinating body for the Network of Indian Agri-Business Incubators (NIABI) which consists of 10 agribusiness incubators spread across the country and covering agriculture and its allied sectors. In fact, India now has the most number of incubators dealing with agriculture and agribusiness.

ABI-ICRISAT holds these agribusiness camps to identify new ideas and innovations that have the potential to transform the lives of the people in the rural sector, especially those engaged in agriculture. This camp, held in partnership with the Technopreneur Promotion Project (TePP) of the Department of Science & Industrial Research (DSIR), Government of India (GoI), aims to tap the vast and existing innovative potential of the people in the country.

The camp will look at promoting innovations and entrepreneurship through technology backstopping and financial support (as grants) so as to take such ideas into conceptual prototypes and into working models that can ultimately be scaled up to benefit the rural community, particularly smallholder farmers. Through such camps, ABI-ICRISAT has so far identified 51 innovations and is currently supporting 26 clients under major schemes from the GoI.



By the end of this activity, we all hope to have a better understanding and appreciation of how agri-businesses can provide an impetus towards shifting agriculture from subsistence to market-oriented mode so that access to farm inputs, market, technology, finance and related services is improved.

Ushering in a new green revolution through agri-business is a reality. Let this be the dawn of a new generation of agricultural entrepreneurs. It is the development of innovative products, processes and concepts by entrepreneurs and their integration into existing agricultural systems that will lead to a sustainable and inclusive agricultural growth.

I wish all the participants great success in this camp.

Thank you!

Technological empowerment and sustainable livelihood for smallholder farmers



Mr Saroj Das, Assistant Director for Pulses, Orissa; partners from DDA Kalahandi, Rayagada and Naurparda; NGOs; and colleagues at ICRISAT, good morning and welcome to this launching meeting-cum-workshop of the Orissa Project on Introduction and Expansion of Improved Pigeonpea Production Technology in Rainfed Upland Ecosystems of Orissa.

We are, today, witnessing a defining moment in the partnership between ICRISAT and the Government of Orissa in working together to enhance agricultural productivity and to improve the livelihood of smallholder farmers in the State. We are deeply honored that you have chosen our Institute as one of your key partners in this project, primarily targeted towards the


Inaugural address, Launch meeting-cum-workshop of the Orissa Project on Introduction and Expansion of Improved Pigeonpea Production Technology in Rainfed Upland Ecosystems of Orissa, 9-10 August 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.

technological empowerment and sustained livelihood of the people of Orissa. We share with you the conviction that beyond the delivery of technology, vital to the State's inclusive agricultural growth is the strengthening of the people's capacity for sustaining innovations.

Orissa is one of the states most affected by poverty and climate change. In Orissa, 70% of the population lives in rural villages and 85% of the total work force depends on agriculture. Moreover, 90% of the total cropped area of 6.1 million hectares is rainfed. In the last few years, extreme weather conditions such as droughts and floods have been affecting 11 million people in 25 of the 30 districts of the State. Agriculture, in particular, has been greatly affected by this unstable weather condition as shown by the reduction in production by 56.4% in pulses and 44% in oilseeds.

Pigeonpea grown by farmers in the area are of poor quality. The varieties used are landraces or improved varieties which are susceptible to diseases





and with a very low seed replacement ratio of 2-3%. Productivity is low at 415 kg ha⁻¹, as against the national average of 700 kg ha⁻¹.

The Orissa project aims to enhance the food and nutritional security and income generation of the underprivileged farmers of rainfed areas of Orissa. It shall also seek to mitigate the adverse effects of climate variability on production and livelihoods in the State through the transfer of improved technology including new varieties and hybrids dovetailed with hands-on training in crop production and management.

A key feature of this project is a systematic seed system concept that will ensure continuous purity of the pigeonpea seeds. This model is what will ensure inclusive growth and development in the area. The pigeonpea value chain will be improved and sustained through proper coordination and appropriate links among stakeholders such as producers, processors and consumers. Value chain innovations are crucial in harnessing the power of markets to speed up productivity growth, livelihood and food security.

We need to empower smallholder farmers to grow their way out of poverty. It is in this framework, that ICRISAT has adopted a new strategic approach known as IMOD or Inclusive Market-Oriented Development. IMOD is a dynamic progression from subsistence towards market-oriented agriculture. And it is this unifying conceptual framework which will guide us in the implementation of our project with you. Propelled by scientific innovations and other support systems, IMOD brings about prosperity to the poor through the generation of surpluses that connects to markets for higher income.

A systems perspective of partnership to run this project will allow us to fight against poverty in the rainfed areas of Orissa not just with a single intervention but in consideration of the interdependent components of the whole agriculture value chain of the project.

We believe that it is through technological innovation and capacity building, and their integration into existing agricultural systems which will lead to a sustainable and inclusive agricultural growth and development, particularly in the rainfed areas of Orissa.

I am sure that by the end of the workshop, you will be able to design meaningful work plans to contribute to the delivery of outputs particularly to Orissa's resource-poor farmers in the upland rainfed areas. I wish you all a productive and rewarding deliberations ahead!

Thank you and good day!




Building climate-resilient rainfed agriculture through sustainable adaptation measures



Distinguished delegates, ladies and gentlemen, good morning and welcome to ICRISAT, the only international center in the semi-arid tropics working towards improving the livelihoods of millions of small and marginal dryland farmers.

I am especially honored to acknowledge with thanks the presence of Dr AK Singh, Deputy Director General, ICAR; Dr SB Dandin, Vice Chancellor of the University of Horticulture; Mr JK Tandon, CEO, Corporate Sustainability, Jindal Steel Works; Dr PK Joshi, IFPRI; Dr B Venkateswarlu, Director, CRIDA; Dr Sachin Oza, DSC; Mr Biswanath Sinha, Sir Dorabji Tata Trust; Mr Gopichandran Ramachandran, Gujarat Energy Research & Management Institute (GERMI); and our friend Mr Mukund Gorakshkar of JSW.

Inaugural address, Roundtable on Climate Change and Rainfed Farming Systems, 16 August 2011, CF Bentley Conference Center, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.



Extreme weather events are already affecting agricultural systems around the world. As global temperatures continue to rise, the pace of environmental change will likely be unprecedented. More frequent and intense precipitation events, elevated temperatures, droughts, floods and other types of damaging weather are all expected to take its tolls on crop yield and quality – making the challenge of feeding an estimated 9 billion people in the world by 2050 exceedingly difficult.

But much more than crop yield and quality, climate change will have far-reaching consequences for agriculture that will disproportionately affect poor and marginalized groups who depend on the sector for their livelihoods and have a lower capacity to adapt. Climate-related crop failures, fishery collapses and livestock deaths already cause economic losses and undermine food security, and these are likely to become more severe as global warming continues. A recent study estimates the annual costs of adapting to climate change in the agricultural sector to be over US\$ 7 billion.

The effects of climate change are more likely to be felt in the semi-arid tropics – home to the deepest pockets of poverty on earth – and where rainfed agriculture is the life line for most small and marginal farmers. A recent study assessing rainfed cereal potential under different climate change scenarios revealed loss of rainfed production potential by 10-20% expected to affect 1-3 billion people by 2080, mostly in the tropical developing countries.

Amid the looming threat of climate change, this discussion aims to address a crucial challenge for all of us – how to evolve adaptation and mitigation strategies to manage the risk and protect the livelihoods of small and marginal farmers who predominate in the rainfed regions.

The relationships among climate change, agriculture and food security are complex and dynamic. But only by understanding this can we come up with solutions, open untapped opportunities to meet the challenge, and devise short-, medium- and long-term adaptation and mitigation strategies. For the most vulnerable people in the tropical developing countries dependent on rainfed agriculture, we need to look at not only the technological but also the social and institutional mechanisms in building the resilience, particularly of resource-poor communities.

ICRISAT's ADB-funded project "Vulnerability to climate change: Adaptation strategies and layers of resilience," is a step towards this direction of understanding the impacts of climate change on the rural poor and most vulnerable farmers in the semi-arid regions of Asia. The project focuses on identifying climate variability (and other related factors) that may be influencing changes in cropping pattern, structures of income and employment, and adaptation-coping strategies of the rural poor in the semi-arid tropics. It shall also seek to identify strategies to address socioeconomic problems relating to changing weather patterns and availability of a range of initiatives for their alleviation. These, along with best practices and

institutional innovations for mitigating the effects of climate change, constitute a multi-dimensional perspective in addressing climate change.

Through the research-for-development initiatives of our Institute, we hope to be able to provide science-based solutions and pro-poor approaches for adaptation, particularly of agricultural systems to climate change.

We believe that to reduce the vulnerability of the smallholder farmers to climate change, we must create a sustainable, inclusive, resilient, profitable and healthy agricultural sector.

At ICRISAT, we believe that this path involves stimulating agro-enterprises to raise rural incomes and create opportunities beyond agriculture. Smallholder farm families have to be empowered and assisted along this development pathway to lead them from pessimism to prosperity. We call this Inclusive Market-Oriented Development (IMOD), a dynamic progression from subsistence towards market-oriented agriculture which will achieve a new level of access to resources, stability and productivity for poor smallholder farmers.

Again, the emphasis of climate change mitigation is to come up with a basket of solutions applicable to different agro-eco typologies and socioeconomic situations in the tropical drylands.



We have come up with science-based and sustainable solutions that have proven what we call “a Hypothesis of hope.” This hypothesis clearly indicates that we can bridge the gap between the farmers’ yield and achievable potential yield to ensure improved food production and livelihoods for the farmers. This, we can do by integrating the adoption of our climate-resilient crops and various soil, water and nutrient management strategies with supporting policies and institutions. Emerging science tools such as remote sensing, modeling and conventional natural resource management technologies will have to be integrated with social and policy interventions to achieve the desired results.

Our approach in building a climate-change resilient rainfed agriculture is holistic. Our research-for-development work will have to be integrated deeply along with that of development workers, policymakers and small and marginal farm holders to achieve the goal of improving livelihoods of millions of poor people in the climate change scenario.

Ladies and gentlemen, we have today an excellent distinguished panel and also distinguished participants. I am sure that this roundtable discussion initiated by the JSW-Times of India Earth Care Award will bring out critical areas which need urgent attention along with a roadmap to operationalize suitable adaptation and mitigation strategies for overcoming the impacts of climate change on rainfed agriculture, not only in India, but in the whole world as well.

I wish all of you a very fruitful deliberation ahead, and may you have a comfortable and pleasant stay here in ICRISAT.

Thank you and have a good day!



Harnessing Plant Growth-Promoting Rhizobacteria (PGPR) for sustainable agriculture




Distinguished guests, ladies and gentlemen,

It gives me great pleasure to be here today at this very important event – the 2nd Asian Plant Growth-Promoting Rhizobacteria (PGPR) Conference jointly organized by Auburn University, China Agricultural University, the Chinese Society of Plant Pathology, and ICRISAT.

I am most grateful for this rare opportunity to address an issue of such magnitude – the sustainability of global agriculture. Let me start by posing this question:

How can we create a more sustainable approach to agriculture while recognizing those wider and important social and economic

Keynote address, 2nd Asian Plant Growth-Promoting Rhizobacteria Conference, 21-24 August 2011, Beijing, China.



parameters – one that is capable of feeding the world with a global population rapidly heading for nine billion in the year 2050?

Going straight into issues related to this, the world now faces “a perfect storm” of factors that could lead to widespread food shortages and public unrest over the next few decades – climate change, population explosion, energy crisis, food crisis, land degradation, shrinking farm holdings, and loss of biodiversity.

The formidable task of meeting the food requirement of the projected nine billion people in 2050 will necessitate a 70% increase in food production, which will require 30% more water and 50% more energy by the middle of the century.

We live in times of great consequence and, therefore, of great opportunity. Given the challenges we face, the opportunity to achieve a healthier, safer and more sustainable, economically robust world can only be met through sustainable agriculture.

PGPR for sustainable agriculture

Sustainable agriculture constitutes several complex definitions, but the commonality among all is that it is based on conserving resources and maintaining and enhancing the quality of the environment while preserving the ability to sustain the world's food needs.

The reduction of losses caused by pests and diseases is the obvious strategy for sustaining agricultural productivity. Approximately 2.5 million tons of pesticides are used in agriculture annually throughout the World (Meena et al, 2008). In India, usage has steadily increased from 2.2 g ha⁻¹ active ingredient (a.i.) in 1950 (David 1995) to 381 g ha⁻¹ by 2007, ie, about 270-fold (Anon 2009).

With increasing pressure on agriculture to produce more food to meet the demand of the growing population come intensive cultivation and increased use of agrochemicals. This has resulted in the depletion of non-renewable chemical fertilizer resources, and problems of toxic residues, pesticide resistance and resurgence of secondary pests. At the same time, plant protection and nutritional inputs can constitute up to 75% of the total input costs of food production. Majority (70%) of smallholder farmers in the semi-arid tropics of the world cannot afford costly chemical inputs.

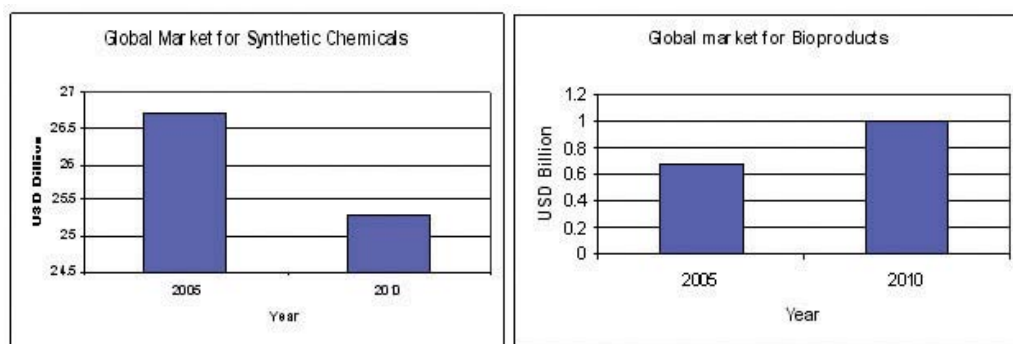
It is in this context that Plant Growth-Promoting Rhizobacteria has gained worldwide importance and acceptance for agricultural benefits, and has recently become the focus of research and resources in many countries. Scientists worldwide are now exploring suitable and effective bio-controls and bio-fertilizers as among the strategies to achieve improved and sustainable production.

Global market scenario

The demand for PGPR-based bio-products, particularly bio-pesticides, is rising steadily in all parts of the world. Public awareness about the environment is increasing, while pollution and health hazards due to synthetic chemicals are growing. Extensive and systematic research has enhanced the effectiveness of bio-pesticides, and as a result farmers and growers are using them in greater quantities.

It has been reported that the total market for global and synthetic pesticides declined at an average annual growth rate (AAGR) of 1.1% in 2010. Meanwhile, the bio-pesticides market is growing rapidly, increasing from \$672 million in 2005 to over \$1 billion in 2010, at an AAGR of 9.9%. This increase was due to several factors such as increased awareness on the environment, commitment to IPM, growing awareness about the ill effects of chemical use, increased demand for healthy food and availability of advanced techniques in pest management; however, the quantity was negligible against chemicals (Valent Bio-Sciences 2006).

There are several bio-pesticides that are commercially available to farmers. According to recent information 175 registered bio-pesticide active ingredients and 700 products are available globally. In India, only 12 bio-pesticides have been registered of which 5 were bacteria, 3 fungal, 2 viruses and 2 plant products. Among various bio-products, *Bacillus thuringiensis* (Bt), *Trichoderma viridae*, *Metarhizium*, *Beauveria bassiana*, Nuclear Polyhedrosis Virus (NPV) and neem are popularly used in plant protection (US Environmental Protection Agency 2007).



Source: Industrial Equipment News Letter <http://www.iem.com/article/biopesticides-market-to/8648>.

Bio-fertilizers and bio-pesticides, however, are still underdeveloped and underutilized in most developing countries due to technical, social, and institutional constraints. The effectiveness and efficacy of bio-agents have yet to be established to be comparable if not to exceed that of agrochemicals.

Bio-fertilizers, for instance, are perceived by farmers to have slow positive effect compared to chemical fertilizers. Some other issues that need to be addressed

include technological constraints and limitations, farmers’ acceptability of the technology, lack of technology promotion and product marketing, financial limitations to pursue further research activities, inadequacy of modern research equipment and laboratory facilities, and inappropriateness of existing policies to the nature and characteristics of bio-agents.

Perception of various stakeholders on bio-products in Asia.		
Stakeholders	Chemical products	Bio-products
Government	Unchanged policies	Encouraged through IPM programs
Farmers	Continuing the existing practice is easier	As a supplement
Consumers	Apparently unfavorable	Favorable
Market forces	Dominant	At infancy
Extension agents	Well-established; easy to adopt	Need strategic extension and capacity building


PGPR at ICRISAT: A success story in sustainable agriculture

Opportunities for developing, using, and commercializing bio-pesticides and bio-fertilizers are vast, particularly in the developing world. At ICRISAT, research results on PGPR have indicated the effectiveness and affordability bio-products, particularly bio-pesticides, toward reduction of agrochemical use in the farming system.

ICRISAT conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics or dryland tropics has over 2 billion people, and 644 million of these are the poorest of the poor. ICRISAT and its partners help empower these poor people to overcome poverty, hunger and a degraded environment through better agriculture.

PGPR for sustainable agriculture is particularly beneficial to the resource-poor, smallholder farmers in the dryland tropics. Biological options of crop protection and production mitigate the increasing cost and negative effects of pesticides and fertilizers particularly in the drylands which is characterized by subsistence farming and a vulnerable, rainfed farming system.

PGPR has such diverse beneficial effects such as pest and disease suppression particularly through biological control; direct growth promotion; increased nutrient availability to plants, stimulation of rhizobium nodulation, and induced systemic disease resistance for increased crop yield and quality; and improved



rhizosphere soil health. PGPR products could serve as an alternative to fossil-fuel-based agricultural inputs, thereby reducing negative environmental impacts of agricultural systems while improving yields and food quality.

ICRISAT's research achievements in PGPR

In recent years, PGPR research at ICRISAT has made significant progress in the identification, production and field evaluation of bio-agents through participatory approach. The virulence of various bio-agents such as NPV, bacteria and plant products was tested and evaluated under hot spots. Substantial progress has also been achieved in strategic research related to feasible production technologies, efficient storage to enhance shelf life, field application, genetic variability, and efficient monitoring. Following are some of the Institute's significant achievements in PGPR research:

- Shared Integrated Pest management (IPM) strategies and technologies involving PGPR;
- Identified and shared beneficial microorganisms with national agricultural research system (NARS) partners, including private sector (PS) companies;
- Demonstrated strategies for reducing pesticide residues in natural resources (soil and water); and
- Augmented natural enemies through eco-friendly approaches.

Success story: The case of Kothapally

In 2000, ICRISAT initiated an integrated watershed management program in Kothapally – a small, remote village in the state of Andhra Pradesh in India faced with regular drought, and where insect pests are the prime constraint to crop yields. Complete dependence on chemical control in the past had led to unsatisfactory pest management, followed by diminishing profits. In 2000, bio-intensive pest management (BIPM) technologies were adopted to alleviate the pest problems in major crops like cotton, pigeonpea, chickpea and vegetables. One of the challenges was to counter the cotton bollworm (*Helicoverpa armigera*), a key insect pest on several crops.

Cotton yields in IPM and chemical plots at Kothapally village. In 2003-06 through BIPM, 32 cotton farmers realized 30% (1.63 t ha^{-1}) better yields compared with farmers adopting conventional methods (1.34 t ha^{-1} ; chemical). They also saved US\$ 80 ha^{-1} by adopting bio-pesticides (conventional farmers spent US\$ 106 ha^{-1} on chemical pesticides).

Effect of bio-pesticides on natural enemies in chickpea ecosystem. Bio-pesticides in chickpea augmented and encouraged natural enemies. There was significant reduction (3.0%) on natural enemies present on the crop over the control, as compared to those with chemical pesticides (60.0%). BIPM farmers also had three

times higher yields of 0.78 t ha⁻¹ compared to 0.25 t ha⁻¹ in non-BIPM fields (>300% increase in yield). This was primarily due to more effective pest management and use of an improved variety (ICCV 37) developed at ICRISAT.

Cost of plant protection in IPM and non-IPM fields at different locations. Before the start of BIPM, the farmers were totally dependent on chemical management, investing about US\$ 24-53 ha⁻¹ on synthetic pesticides. Adoption of BIPM in the village led to 21-56% reduction in pesticide use by 2000. Some villages also became totally pesticide-free through effective implementation of BIPM by the year 2000.

No. of locations (NGOs)	Cost of plant protection (US\$ ha ⁻¹)		Cost reduction in IPM over control (%)
	IPM	Non-IPM	
14	13-23	20-37	21-56

Reduction in insecticidal sprays (%) after the implementation of IPM in different villages 2005-07. Implementation of IPM resulted in significant reduction of chemical use across crops. Intensive on-farm IPM activity involving 17 villages with 261 farmers in Andhra Pradesh clearly brought about a 21-65% reduction in pesticide sprays in different crops with maximum reduction in the key cotton crop (65.1%), paddy (25.6%) and pigeonpea (24.3%).

Impact of IPM on pesticide residues in water. The total residue concentrations of pesticides were greater in water samples from bore wells (0.036 mg kg⁻¹) than from open wells (0.023 mg kg⁻¹). It is interesting to note that effective implementation of IPM in these villages for the last ten years revived the contaminated water situation in both open as well as bore wells. This can be an effective model worth pursuing in the reclamation of pesticide-polluted water sources.

Chemical	Residue levels (mg kg ⁻¹) in water samples from Kothapally			
	2007		2009	
	Bore well	Open well	Bore well	Open well
Monocrotophos	0.003 (<0.001-0.004)	0.002 (<0.001-0.002)	0.0	0.0
Chlorpyrifos	0.012 (<0.001-0.018)	0.011 (0.004-0.017)	0.0	0.0
Endosulfan	0.004 (<0.001-0.005)	<0.001 (<0.001)	0.0	0.0
Cypermethrin	0.017 (<0.001-0.029)	0.009 (<0.001-0.009)	0.0	0.0
Total	0.036	0.023	0.0	0.0

Bio-products research consortium @ ICRISAT

PGPR-based products – bio-fertilizers and bio-pesticides – are still underdeveloped and underutilized in most developing countries due to technical, social, and institutional constraints. The effectiveness and efficacy of bio-agents have yet to be established to be comparable if not to exceed that of agrochemicals. Some other issues that need to be addressed include technological constraints and limitations, farmers' acceptability of the technology, lack of technology promotion and product marketing, financial limitations to pursue further research activities, inadequacy of modern research equipment and laboratory facilities, and inappropriateness of existing policies to the nature and characteristics of bio-agents.

ICRISAT believes that public-private partnership (PPP) is vital in enhancing agricultural production, reducing rural poverty, and fostering sustainable and inclusive agricultural growth and development particularly in the developing world. Inclusive Market-Oriented Development (IMOD) is ICRISAT's new approach to link farmers and address market-oriented development goals. PPP as a vital component of IMOD, enables pooling of resources and minimizing risks in R&D investments for mutual benefit; enhances synergy between social equity of public institutions and efficiency of private sector (PS) delivery; and allows a progressive way of widening access to technology and enhancing product development.

ICRISAT initiated a consortium called "Bio-products Research Consortium (BRC)" in 2005 as a PPP initiative, focusing on engaging India's private sector in delivering research outputs, capacity building and technologies leading to mass-scale production of quality bio-products.

The BRC's main mission is to lay the groundwork for the continued successful commercial development of PGPR-based products through PPP, scale up studies in addressing eco-friendly approaches to bring substantial reduction in pesticide use without sacrificing yields, and further spread and increase awareness and adoption of bio-products.

Objectives of BRC

- Screen microbial germplasm with ability to suppress insect pests and diseases from new niches.
- Develop promising entomopathogens and improve their delivery to partners and farmers.
- Determine the compatibility with other plant protection options, for enhancing their efficiency.
- Field evaluations of promising ones through farmer participatory approach.

Facilities/services for BRC partners

- Microbial germplasm.
- Microbial isolation and evaluation techniques.
- Mass multiplication methods.
- Laboratory and field bioassays.
- On-farm evaluation support.
- Training for partners on all the above.

Partnership process

- Any organization with interest in bio-products can join the consortium.
- The products of this collaborative research will be available through a Memorandum of Agreement (MoA).
- ICRISAT provides training to technical staff of partners.
- Research on bio-products will be consistent with ICRISAT's mission and mandate.

Significant outputs achieved


- New formulations of *B. subtilis* strain BCB 19 developed.
- Formulations of *M. anisopliae* produced.
- Field bio-efficacy data for the above two strains generated.
- Identification of actinomycetes with ability to manage *Helicoverpa*.
- Powder formulations of *Helicoverpa armigera* nuclear polyhedrosis virus (HaNPV) developed.
- Microbial germplasm made available to members.
- NPV quality control and monitoring technique using ELISA developed.
- Level of farmers' confidence in bio-pesticide-based plant protection improved.

Constraints/limitations in the commercialization of PGPR strains

- Knowledge gap on microbial ecology and pathogen interactions (including compatibility).
- Complicated registration policies.
- Lack of favorable promotion policies from governments.
- Limited extension capacity on bio-pesticides.

Prospects and future directions

PGPR research at ICRISAT has been focused on the identification, production and field evaluation of bio-products through participatory approach, public-private partnership through the consortium approach towards the continued successful commercial development of PGPR-based products.



ICRISAT in collaboration with the national agricultural research systems has assisted in improving the capacity of several researchers and farmers on bio-pesticide production, and established 96 village-level NPV production units in India and Nepal. On-farm studies on bio-pesticides indicated substantial reduction in pesticide application from 11 to 4 sprays in cotton, 2.1 to 1.6 sprays in rice, 2.9 to 2.2 sprays in pigeonpea, and 2.9 to 2.3 sprays in chickpea.

In the bio-products research at ICRISAT, following are some of the valuable lessons learned:

- Capacity of producers and consumers need to be enhanced by emphasizing the benefits of bio-products;
- Bio-products require specialized skills and are effective in specific situations;
- Secondary metabolites of bio-products were found effective on multiple targets (pests and diseases);
- Bio-pesticides that can perform effectively in varied environments have immense potential; and
- Though eco-friendly approaches have been advocated for three decades, only 38% of the farmers in Asia were aware of bio-pesticides, and adoption is still low.

Although bio-pesticides still represent a very small portion of plant protection at present, their role is considered significant. Bio-pesticides have gained prominence as environment-friendly alternatives to chemical insecticides, yet they face a number of hurdles in their production, marketing and utilization. Hence, the importance of effective multidisciplinary research, and PPP partnerships is emphasized. Following are the directions we should take to move forward:

- Popularization of PGPR products
- Creating awareness among the target community
- Field demonstrations
- Farmers days
- Capacity building of commercial producers/farmers
- Partnerships with purpose
- Technical support to industry partners
- Policy support from Governments
- Effective multidisciplinary research; and
- Need for effective public-private-people partnerships.

Finally, allow me to bring you back to where my talk started – sustainable agriculture, which in its simplest definition is a way of raising food that is healthy for consumers and animals, does not harm the environment, is humane for workers, respects animals, provides a fair wage to the farmer, and supports and enhances rural communities.

Clearly, agriculture must continue along the sustainable path to meet the increasing global demand for food, without exceeding the environment's "carrying capacity." Hence, further food production increases must be generated by the sustained use of technologies that are ecologically sound, socially equitable, economically viable, and environmentally sustainable. As sustainable agriculture continues to be the only option, PGPR-based products could hold the key.

Thank you very much, and I wish all of you a fruitful and rewarding deliberation ahead.




Improving pulse productivity through genomics



Colleagues, ladies and gentlemen, good morning and welcome to this Annual Planning and Review meeting of two projects – the Center of Excellence in Genomics (CEG Phase-II): Translating Genomics Research for Pulse Improvement and Deployment of Molecular Markers in Chickpea Breeding for Developing Superior Cultivars with Enhanced Disease Resistance funded by the Department of Biotechnology (DBT), Government of India (GOI).

A critical step in achieving sufficient and nutritious legume foods particularly for the world's poor is the adoption of improved varieties. Hence, I am extremely pleased to note that our efforts in molecular breeding are now in high gear towards improving leading

Inaugural address, Annual Planning and Review meetings of projects CEG Phase-II: Translating Genomics Research for Pulse Improvement and Deployment of Molecular Markers in Chickpea Breeding for Developing Superior Cultivars with Enhanced Disease Resistance, 29 August 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.



pulse crops such as chickpea and pigeonpea. I am likewise pleased that under these two projects, we are bringing together multiple partners and institutions in combating production constraints by employing genomic tools developed in the last five years.

Grain legumes play a major role in reducing malnutrition of the 2 billion malnourished people in the world today. Grain legumes are currently grown on about 195 million ha globally, mostly in developing countries where majority of the poor and malnourished people live.

There is an unmet need for grain legumes as demand exceeds current production. This demand is expected to grow by 1% per year through 2020. Meeting this demand will require increasing total production through both productivity increase and tapping potential new niches for cultivation.

Increasing grain legume production, trade and consumption would help reduce food and nutrition insecurity, improve livelihoods of resource-poor farmers, and ensure availability and affordability of grain legumes to poor rural and urban consumers.

However, the agricultural path is currently faced with various challenges – warming temperatures, droughts, floods, increasing land degradation, loss of biodiversity, rising food prices, rising energy demand and population explosion – and their convergence, if unabated, will lead to what is now dubbed as a ‘perfect storm’.

Climate change is likely to affect traditional areas where grain legumes are grown. Most tropical countries are likely to lose up to 50% crop yields (productivity) in some areas. This will lead to grain legumes being grown in areas that are likely to produce lower yields. Hence, there is an urgent need to develop cultivars that are adapted to warmer temperatures.

These challenges can be met with high-yielding, more resilient cultivars and better management practices. New science and strategic partnerships improve the chances of finding solutions to these challenges.

Particular to India, which is the leading producer of both chickpea and pigeonpea, serious production constraints like fusarium wilt, Ascochyta blight and drought in chickpea, as well as fusarium wilt and sterility mosaic disease (SMD) in pigeonpea have resulted in very low productivity of these crops. Modern genomic approaches in the breeding program of these pulse crops may hold the key in combating these production constraints.

In the past, molecular breeding has been mainly focused on cereals, resulting in the dearth of genomic resources in pulse crops. In the last five years, however, as a result of significant efforts of partner institutions like all of those gathered here today, significant increase in pulse crops genomic resources have been achieved.


This has been possible primarily due to the strong support of partners like ICAR, DBT, GCP, etc. It is important to mention here that DBT was instrumental in the establishment of the Center of Excellence in Genomics in 2005. Encouraged by the success of the first phase, DBT again sponsored the second-phase implementation of the CEG.

I am likewise pleased to learn of the commitment and dedication of our leading national partners like the Indian Institute of Pulse Research (IIPR, Kanpur), Indian Agricultural Research Institute (IARI), and Acharya NG Ranga Agricultural University (ANGRAU), in the implementation of CEG phase-II. CEG is now establishing modern marker genotyping facilities that will be offered to national partners on cost-to-cost basis. Furthermore, the CEG has a plan to train another 50 scientists in the area of molecular breeding in addition to the 200 scientists trained in the last eight training courses.

I am also happy to note that scientists from ICRISAT and partner institutions are using tools and approaches developed in other projects such as the Tropical Legume I (TL-I) of the Bill & Melinda Gates Foundation and the Indo-US Agricultural Knowledge Initiative in molecular breeding for drought tolerance in chickpea.

As a part of these initiatives, IIPR, IARI and ICRISAT are now in the forefront of developing superior lines for drought tolerance in chickpea. Similarly, the Jawaharlal Nehru Krishi Vishwa Vidhyalaya (JNKVV, Jabalpur), Mahatma Krishi Vidyapeeth (MPKV, Rahuri), ARS-Gulbarga and ICRISAT are leading efforts to deploy molecular breeding for disease-resistant varieties. In the case of pigeonpea, collaborators are engaged in molecular mapping for fusarium wilt and SMD.





ICRISAT's strategy to 2020 is about harnessing markets to achieve our four mission goals: to elevate the poor out of poverty, hunger, malnutrition and environmental degradation across the dry tropics of the developing world, aided by purposeful partnerships. The strategy is called Inclusive Market-Oriented Development or IMOD.

We have defined six developmental outcomes that we believe will help the poor move along the IMOD path – food sufficiency, intensification, diversification, resilience and two cross-cutting outcomes, namely, nutrition and health and empower women. Significant reductions in poverty and increases in food security in the dryland tropics are possible through this route.

In this context, modern science tools like genomics and transgenic technologies are very important to accelerate crop improvement towards contributing significantly to the achievement of our developmental outcomes. ICRISAT is well-placed to use these technologies with strong support from the GOI, particularly from the DBT.

In the last five years, we have witnessed the development of significant genomic resources of leading grain legume crops of India and of its mandate crops. Orphan legume crops are now genomic resource-rich crops. Molecular breeding in legumes has become a reality, just like in chickpea and in pigeonpea.

Finally, let me take this opportunity to particularly thank the DBT and the Indian Council of Agricultural Research (ICAR) for supporting research on molecular breeding in these leading pulse crops.

Wishing you the very best in your deliberations!

Thank you!

Together harnessing crop diversity to benefit smallholder farmers*



Good morning and welcome to Hyderabad!

We are very pleased that the Generation Challenge Program (GCP) has selected Hyderabad, India, as the venue of its first General Research Meeting, Phase II.

ICRISAT has had a long history of excellent partnerships with the GCP since its inception. Our leading scientists, earlier Jonathan Crouch and currently Rajeev Varshney, have served part time as Sub-Programme Leaders with the GCP. Since 2007, Rajeev has been Leader for the Sub-Programme 2 and now Theme 1.

Genetic diversity holds the key to the ability of plant species to persist over evolutionary time through changing

**Welcome and inaugural address,
General Research Meeting (GRM) of
the Generation Challenge Program
Meeting, 21 September 2011,
Hyderabad, India.**

*Delivered by Peter Ninnies, Director,
Resource Planning and Marketing
(RPM), ICRISAT.

environments. Providing a new generation of resilient plants that meet the farmer's needs is possible by using advances in molecular biology and harnessing the rich repository of crop genetic resources.

International agricultural research has often been plagued by problems of sustainability and the inability of NARS partners to implement novel methods in science. The GCP was probably the first CGIAR initiative that strove to harness crop diversity by using genomic tools and approaches, especially in CGIAR centers and among NARS partners. In 2003, the GCP filled this vacuum by bringing ARIs and NARS together with CG centers.

Lately, the GCP's activities in Phase II have shown a clear shift towards 7 crop-trait combinations. The GCP and its management team led by Jean-Marcel Ribaut are geared up to take the work forward in this direction. I understand that they had an excellent EPMR and are visible across the world for their significant contribution to crop breeding.

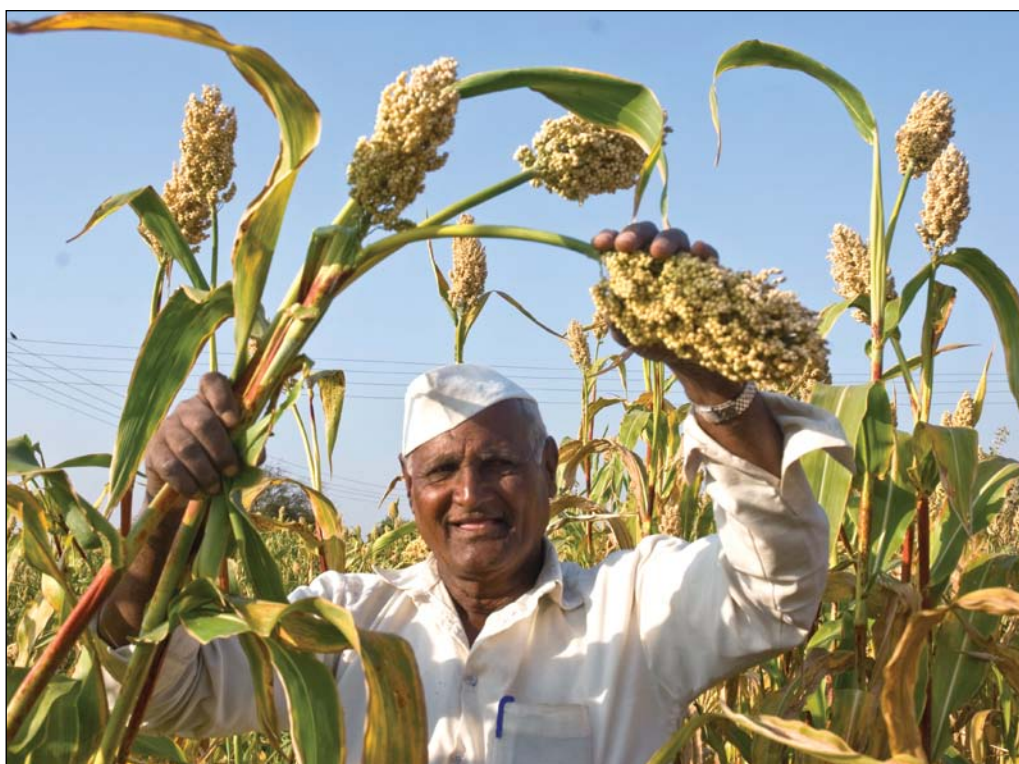
In partnership with the GCP and several ARIs and NARS, ICRISAT has been engaged in various upstream as well as downstream research activities. For instance, crops that used to be generally considered as less-studied in terms of genomics have now become rich in genomic resources. Crops like pigeonpea and pearl millet that are very important for the livelihoods of poor people in subsistence farming systems are joining the league of major crops in terms of genomic resources. Crops like chickpea, sorghum and groundnut have ushered in the molecular breeding era where earlier only major cereal crops like rice, maize and wheat were leading. ICRISAT together with its national partners is using molecular breeding to enhance crop productivity.




ICRISAT has been playing an active role in the collection, conservation, characterization and sharing of germplasm of dryland crops and their wild relatives. Our Genebank holds over 119,000 accessions from 144 countries of our mandate crops and has distributed more than 1.3 million samples to scientists. Germplasm collections that had been lost due to calamities have been restored in Botswana, Sudan, Cameroon, Ethiopia, Kenya, Nigeria and Somalia in Africa and in India and Sri Lanka in Asia. Although we have been engaged in tapping this diversity for crop improvement, these efforts have now been enhanced as the GCP has facilitated genotyping of over 10,000 accessions in our Genebank.

At ICRISAT, our strategic plan to 2020 lays emphasis on expanding the collection of wild relatives of mandate crops; filling gaps by collecting landrace varieties, and pre-breeding analysis to access diverse traits for use in research, including efforts to understand genome diversity for a majority of its collection. We look forward to the active participation of the GCP and other partners like ICAR in achieving this goal.

Bioinformatics and biometrics play key roles in genome analysis and crop improvement programs, and the GCP has been quite supportive in establishing these facilities at ICRISAT. These experiences have been mutual. For instance, together with CIMMYT and IRRI, ICRISAT developed the iMAS programme in the first phase of the GCP that is being used extensively by NARS partners. And





now in Phase II, our scientists from genomics, bioinformatics and biometrics are developing analytical tools to analyze the next generation sequence data. Similarly, ICRISAT is a major partner with the GCP in its Integrated Breeding Platform. We are working with them to develop tools and databases to help the molecular breeding programme of NARS partners. It is also important to mention that ICRISAT is offering marker genotyping services to GCP partners on a cost-to-cost basis through its Center of Excellence in Genomics. Recently, with the help of the Department of Biotechnology, Government of India, we set up SNP genotyping facilities, which I am sure will strengthen our ties with the GCP.

Capacity building is another major area where the GCP and ICRISAT have been partners. Together, they have organized several training courses and imparted molecular breeding skills to national programmes. In addition, ICRISAT has been organizing workshops for the GCP during the last five years.

In summary, ICRISAT and the GCP have been very strong partners in research in harnessing crop diversity through genomics tools for crop improvement. At present ICRISAT is a major partner with GCP in the Tropical Legume I project, and three of seven research initiatives namely - Sorghum, Chickpea and Comparative Genomics. We hope that like us, GCP is happy with their partnership with us.

In the current CGIAR reforms, ICRISAT is leading two CRPs on dryland cereals and grain legumes. We have embedded the GCP's research portfolio on cereals and legumes in the respective CRPs. This will enable us to collaborate more closely in the interest of agriculture and smallholder farmers.

I hope the GCP community will have a productive meeting here. ICRISAT will be happy to extend every help to make your stay pleasant.

Have a great day!

Climate change and its impact on agricultural productivity and livelihood: Technology and policy response*




Thank you very much for inviting me to speak on this momentous occasion – the University of Agricultural Sciences, Dharwad's silver jubilee celebration marked by the 71st Annual Conference of the Indian Society of Agricultural Economics.

I am especially honored for giving me this rare opportunity to speak and provide profound policy and technological responses to climate change and its impact on agricultural productivity and livelihood.

Extreme weather events are already affecting agricultural systems around the world and its 7 billion people. As global temperatures continue to rise, the pace of environmental change will likely be unprecedented.

*Delivered by Dr MCS Bantilan,
Research Program Director, Markets,
Institutions and Policies (MIP), ICRIAT.

**Address as Chief Guest, 71st Annual
Conference of the Indian Society of
Agricultural Economics, 3-5 November
2011, University of Agricultural
Sciences, Dharwad, Karnataka, India.**



More frequent and intense precipitation events, elevated temperatures, droughts, floods and other types of damaging weather are all expected to take its tolls on crop yield and quality – making the challenge of feeding an estimated 9 billion people in the world by 2050 exceedingly difficult.

But much more than crop yield and quality, climate change will have far-reaching consequences for agriculture that will disproportionately affect poor and marginalized groups who depend on the sector for their livelihoods and have a lower capacity to adapt.

Climate-related crop failures, fishery collapses and livestock deaths are already causing economic losses and undermining food security, and these are likely to become more severe as global warming continues. A recent study estimates the annual costs of adapting to climate change in the agricultural sector to be over US\$ 7 billion.


The effects of climate change are more likely to be felt in the arid and semi-arid tropics – home to the deepest pockets of poverty on earth – and where rainfed agriculture is the lifeline for most small and marginal farmers. A recent study assessing rainfed cereal potential under different climate change scenarios revealed loss of rainfed production potential by 10-20% expected to affect 1-3 billion people by 2080, mostly in the tropical developing countries.

Amid the looming threat of climate change, the theme of this conference is very timely and fitting. It is an opportune time for us to address the crucial challenge of how to evolve adaptation and mitigation strategies and policies to manage the risk and protect the livelihoods of small and marginal farmers who predominate in the rainfed regions.

The relationships among climate change, agriculture and food security are complex and dynamic. But only by understanding this can we come up with solutions, open untapped opportunities to meet the challenge, and devise short-, medium- and long-term adaptation and mitigation strategies.

For the most vulnerable people in the tropical developing countries dependent on rainfed agriculture, we need to look at not only the technological but also the social, institutional and policy mechanisms in building the resilience, particularly of resource-poor communities.

I would particularly like to focus my talk on climate change and the havoc it can cause to agriculture. Building on assessments of six climate models and two crop modeling approaches, Cline (2007) concludes that global agricultural output could decrease between 6-16% by 2080, assuming a 4.4 degree increase in temperature and 2.9% decrease in precipitation, depending on the effects of CO₂ fertilization.



A recent study assessing rainfed cereal potential under different climate change scenarios has revealed 10-20% loss of rainfed production potential that is expected to affect 1-3 billion people by 2080, mostly in the tropical developing countries.

ICRISAT's climate change 'Hypothesis of hope' states that how farming systems cope with *current* rainfall variation is likely to yield important clues for adapting to *future* climate change. We believe that we can bridge the gap between the farmers' yield and achievable potential yield to ensure improved food production and livelihoods for the farmers.

This, we can do by integrating the adoption of our climate-resilient crops and various soil, water and nutrient management strategies with supporting policies and institutions. Emerging science tools such as remote sensing, modeling and conventional natural resource management technologies will have to be integrated with social and policy interventions to achieve the desired results.

We believe that a progressive policy environment is equally important to see results on the ground. We should encourage more investment in infrastructure and education and research that improves understanding and prediction of climate-agriculture interactions, water policies, and land-use policies to encourage diversification and natural resource management, among others.

Policies that encourage private sector engagement; enhance the effectiveness of rural institutions at the local, national and international levels; enable better access to credit and agricultural inputs; acknowledge the role of women in agricultural production; and contribute to value chains in the agricultural sector are equally important.

Also essential are the role of weather and climate services and products in developing adaptation solutions; stock-taking of available climate information; collaboration between national and international providers of climate information and users; and generating awareness among different user communities of its usefulness.

Until recently, most scientific assessments on climate change were focused at a macro/regional level. ICRISAT's ADB-funded project on "Vulnerability to Climate Change: Adaptation Strategies and Layers of Resilience" has generated valuable outputs that will have policy and livelihood impacts for the rural poor and vulnerable farmers in the semi-arid regions of Asia, particularly in Bangladesh, India, Pakistan, the People's Republic of China (PRC), Sri Lanka, Thailand and Vietnam.

The project will benefit the poor, marginalized, and vulnerable by informing them of adaptation and mitigation strategies; improved strategies for managing risk and vulnerabilities that will diversify their sources of livelihood and provide alternative coping strategies.

With institutional innovations; new policy, institutional and technological options, these will lead to improved management of scarce water resources and reduced resource degradation; and improved databases, information and training that will enhance their capacity for adaptation strategies.

Let me share some of the findings from our study in India which may be of interest to you. In terms of cropping patterns, the last four decades have seen farmers shift from cereal cultivation to short-duration drought-tolerant crops like soybean, etc.


Where new irrigation potential has been created like in Shirapur in Maharashtra, sugarcane has replaced prevalent crops to increase their incomes. Mixed cropping is being practised in some villages to counter the risk of income failure, and fodder crops have gained importance due to demand from the dairy industry.

Coming to trends in livestock, farmers have diversified their incomes from milk production by relying on exotic breeds and improved feed management. Government initiatives have aided the generation of non-farm incomes. Access to input markets in most of the villages have improved in recent times with most inputs available within the village or nearby village/town.

However, farmers' major constraints have been the non-availability of drought-tolerant varieties, lack of access to supplementary irrigation; non-availability of potential technologies; and lack of capacity for crop diversification by marginal farmers.

Farmers also face lack of access to credit against risk, and of efficient cooperatives/associations tackling risks; governance issues and a dearth of incentives to adopt soil and water conservation practices.





At ICRISAT, through our research-for-development initiatives, we hope to be able to provide science-based solutions and pro-poor approaches for adaptation of agricultural systems to climate change.

We believe that to reduce the vulnerability of the smallholder farmers to climate change, we must create a sustainable, inclusive, resilient, profitable and healthy agricultural sector.

We are pursuing this path through an approach that involves stimulating agro-enterprises to raise rural incomes and create opportunities beyond agriculture. Smallholder farm families have to be empowered and assisted along this development pathway to lead them from pessimism to prosperity.

We call this IMOD or Inclusive Market-Oriented Development, a dynamic progression from subsistence towards market-oriented agriculture which will achieve a new level of access to resources, stability and productivity for poor smallholder farmers.

Our approach in building a climate-change resilient rainfed agriculture is holistic. Our research-for-development work will have to be integrated deeply along with that of development workers, policymakers and small and marginal farm holders to achieve the goal of improving livelihoods of millions of poor people in the climate change scenario.

We need to tackle these issues seriously to free the smallholder farmer in the dryland/rainfed areas from the pincers of poverty and food insecurity. Agricultural universities too are being challenged to transform their role in higher education and their relationship to the evolving global food and agricultural enterprise.

Addressing the relationship between climate change and agriculture will require the sharing of insights by a diverse set of experts and actors, from scientists/academicians and engineers to regulators and policymakers. That is happening here today.

I am sure that at the end of this conference, new insights will be gained that will bring about critical areas which need urgent attention.

Let us all work together to come up with a roadmap to operationalize suitable adaptation, mitigation and policy measures for overcoming the impacts of climate change on agricultural productivity and livelihood not only in India, but in the whole world as well.

Thank you very much!



Working with farmers is a must



Ladies and gentlemen, good morning and welcome to this Annual Review and Planning Meeting of IFAD Grant 954.

We are pleased and honored to acknowledge the presence of Dr Ashok Seth, Consultant, IFAD, Rome to this meeting. This project will be completed this coming December. However, soon after this meeting, we plan to request IFAD for a six-month no-cost extension to enable our partners to complete the activities of postrainy season in India and Nepal and of autumn-winter season in Vietnam.

It has been a long and fruitful journey of four years with lots of significant achievements, lessons and experiences. You would be hearing

Welcome address, IFAD Grant 954-ICRISAT Annual Review and Planning Meeting, 14-16 November 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.

about these in the next two days when the project partners make their respective presentations.

The project has largely achieved its objectives and has sensitized the NARS and policymakers about the usefulness of the FPRE approach in agricultural research and development.


The regular interactions between farmers and scientists under this project have ignited a strong desire among farmers to learn more to improve their agriculture and livelihoods. A key part of our commitment is making agricultural research-for-development work for the poor, a commitment embodied in our principle of “Science with a human face”.

The IFAD Grant 954 project was built on the gains of an earlier project, IFAD Grant 532. In its initial years, the project generated/ refined existing technologies in partnership with the farmers. In the current project, the emphasis was on up-and out-scaling of the technologies to a larger number of farmers. This way, more stakeholders will share the benefits from the project.

It will also encourage lead farmers to serve as ambassadors in promoting our improved and environment-friendly technologies. A good example of this is groundnut variety ICGV 91114 in Anantapur district in India which farmers have started propagating themselves.

This Grant project of IFAD has established close linkages with IFAD investment projects in Chhattisgarh, Jharkhand and Orissa states in India, western mid-hill region in Nepal, and Tuyen Quang and Ha Tinh provinces in Vietnam. This opportunity to collaborate with IFAD investment projects has allowed us to work with the poorest of the poor in tribal areas.





We were able to adopt varied levels of technology interventions depending upon the socioeconomic conditions and resourcefulness of the farmers. We now hope that with these investment projects, up-scaling and out-scaling of generated technologies can be facilitated.

The participation of India, Nepal and Vietnam in this IFAD project ensured the wide sharing of technologies within the Asian region. This coalition of partners brought in significant synergy in our efforts to help alleviate poverty by increasing legumes productivity in rainfed Asia.

Further, exchange visits and rotation of Project Steering Committee Meetings among the partner countries allowed project partners to learn from each other.

This project also highlighted issues of socioeconomic importance which have strong bearing on sustainable project gains. While aware of the value of improved varieties, poor farmers in many areas were unable to save their own seed. Soon after harvest, they would sell their produce of improved varieties as they need cash to clear loans and meet other family obligations.

Linkage with markets and value additions are some of the other issues. Hence, while consolidating the gains made in the current project, it is also important to address issues that have emerged.

A lot remains unfinished. A new project will help complete these tasks. At this juncture, I would like to acknowledge IFAD for its consistent support to ICRISAT. I would also like to give special mention to Drs Ganesh Thapa and Ashok Seth who have greatly helped us in developing a new project that will sustain our gains in this current project.

I wish you success in all your deliberations, and I am confident that these will provide valuable guidance so that the goal and objectives of the new project will be successfully achieved.

With us working together, we will indeed sow the seeds of success in winning the Grey to Green Revolution in rainfed Asia!

Thank you and good day.



Water management for sustainable agricultural growth



Distinguished guests, ladies and gentlemen, good morning!

First of all, let me extend my warm welcome to all our partners who have assembled here today to discuss water-enabled sustainable agricultural growth in Karnataka. Let me acknowledge the important presence of Dr KV Raju, Economic Advisor to Hon'ble Chief Minister of Karnataka and Mr Kajetan Hetzer, Water Resource Group representing the World Economic Forum.

We also welcome Mr Batsiaan Moohrmann, , International Finance Corporation, World Bank Group; Mr Gurupadaswamy, Secretary to Govt. WRD, Bengaluru; Mr Laxman Rao Peshwe, Managing

**Inaugural address, WRG–GoK,
Ministry of Water Resources–ICRISAT
Brainstorming Workshop for
Developing Water-enabled Sustainable
Agricultural Growth Pilot Design, 18
November 2011, PTTC Conference Hall,
ICRISAT-Patancheru, Andhra Pradesh
502 324 , India.**



Director, KNNL, Bengaluru; and Mr Kapil Mohal, Managing Director, KBJNL, Bengaluru.

My special welcome also goes to industry representatives from SAAB Miller, Nestle and Jain Irrigation Systems Ltd who are here to join our efforts in achieving water-enabled sustainable agricultural growth in Karnataka through this consortium. I also welcome representatives from the University of Agricultural Sciences, Bengaluru and Dharwad and our sister institutions from IWMI and ILRI.

The subject of this workshop – Water-enabled sustainable agricultural growth – is very timely and fitting, and has immense importance as well as complexities associated with it. Water, which is the most scarce commodity today in the world, is directly linked with development goals of food security and poverty reduction.

While water availability over the last 50 years has not changed worldwide, in some countries like India, per capita availability has declined dramatically due to increasing human population.

India's average rainfall per annum is 1170 mm, which is greater than the world average rainfall of 1100 mm.

India is also fortunate to have the highest rainfall-receiving area in the world. In spite of this, the country has an average of 20 day water-storage capacity in dams, unlike in other places like the Colorado State and the Murray-Darling project with 800-900 days storage capacity.


Taking these into account, it becomes clear how critical and important it is to tackle water-related issues in the country, and in realizing enabling mechanisms for sustainable agricultural development.

We are very pleased, therefore, that the Government of Karnataka is taking this vital step toward convergence to achieve sustainable development through science-led interventions in the area of water management.

ICRISAT has done pioneering work in enhancing rainwater use efficiency and in increasing productivity of rainfed crops, as the Bhoochetana program and other similar undertakings in the country have shown. There exists a large opportunity to enhance water-use efficiency and minimize water losses in the country to meet the growing challenges of producing more with less water. However, business as usual will not work.

We need to develop and adopt a new framework to tackle the complex issues of enhancing water use efficiency, reducing water transmission losses, producing more food and increasing incomes of smallholder farmers. We need to adopt the principles of convergence, consortium, collective action and capacity building.

We have to bring about synergy among all stakeholders to tap the power of partnership to create real impacts on the ground. In particular, we have to



explore the full potential of public-private partnership (PPP) –with government line departments, research organizations and institutions working along with the private sector to improve the livelihood and well-being of smallholder farmers.

I am pleased to note that WRG of the World Economic Forum and the Indian Finance Corporation have taken the lead in forging this public-private partnership to realize the mission of water-enabled sustainable agricultural growth in Karnataka. From us in the CGIAR system, we have already been adopting the consortium approach; in fact, ICRISAT along with IWMI, ILRI and IRRI have already been working with our partners in operationalizing an integrated approach for the sustainable development of Karnataka.

There is a need for an integrated water resource management strategy which should be farmer-centric, sustainable, science-led, participatory and partnership-based with a purpose. We should adopt the principles of sustainable intensification and diversification, Inclusive Market-Oriented Development and building human capital with enabling institutions and policies for the success of the pilot projects.

I am sure that in the next two days, you will all bring in the best of ideas and will deliberate and put forward broad principles, expected outputs, milestones, detailed strategy, potential partners and individual responsibilities for the pilot projects to succeed.

I wish you all the best, and once again, I congratulate the Government of Karnataka for taking this bold step toward the realization of sustainable agricultural growth in the State.

Thank you and a pleasant day to all!



Agribusiness incubation for inclusive and sustainable agricultural growth




Incubator managers of the AIIC, representatives from FARA, UniBRAIN, PanAAC, ANAFE, ASARECA, CORAF, SADC, trainers from *infoDev* and other agencies, colleagues from the Philippines, ladies and gentlemen-

Welcome to ICRISAT!

Over the past three years, food security, poverty, and economic crises have highlighted both the urgent need and the potential for developing an inclusive, market-oriented, and sustainable agricultural growth worldwide.

Out of the 7 billion people today, one billion people lack access to adequate food and nutrition. By 2050, the

Keynote address, Training Program on Strengthening the Capacity of UniBRAIN Agribusiness Innovation Incubator Consortia (AIICs), 21 November 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.



global population will surpass 9 billion people, and demand for agricultural products is expected to double. At the same time, the world's agricultural systems will be increasingly challenged by climate change, water scarcity, land degradation, and volatility hence raising the risk of production shortfalls.

Amid these pressing challenges, sustainable agricultural growth through market-based solutions is the key. This training program, hence, is timely and fitting as it emphasizes on the role of entrepreneurship and business incubation in revitalizing the agricultural sector.

Entrepreneurship in agriculture has the potential to improve the productivity and income of the farm sector, leading to improved livelihood of the people, enhanced food and nutritional security, and faster economic growth of the country.

We at ICRISAT believe that farming must be done as a business and one of our critical focus areas involves fostering agro-enterprises. Our new Strategic Plan to 2020 strongly speaks of our commitment to Inclusive Market-Oriented Development or IMOD.

IMOD is a dynamic progression from subsistence to market-oriented agriculture. It starts by increasing the production of staple food crops, and converting deficits into marketable surpluses that are sold into markets. This inclusive strategy will enable the poor, particularly women and the youth, to participate, rather than be sidelined in the development process. We believe this approach would help in reducing poverty since markets create demand for a wider diversity of higher-value foodstuffs and agro-industrial products.

In this context, entrepreneurship through small and medium enterprises (SMEs) in the agricultural sector needs to be encouraged. However, we know that every business venture has risks associated with it, especially in the agriculture sector. This is the challenge that agribusiness incubators and managers like you face.

Entrepreneurship promotion will not only help in commercializing ventures and in job creation to bring money into the rural economy. It will also help in filtering down more technological innovations from the research and development (R&D) sector into marginalized, smallholder farming communities.

Globalization has triggered consumers to demand for more value-added products. This again is an opportunity for the farmers to generate better returns from their crops.

Agribusiness incubation plays a direct role in ensuring food security and poverty reduction. According to the US Agency for International Development (USAID), there are three distinct variables central to the attainment of food security and poverty reduction:

- Availability – referring to sufficient quantities of food and food products available for consumption. Agribusiness incubators like you working along high-priority value-chain interventions contribute to this initiative, by providing your clients primarily with technical and marketing support.
- Access – referring to an individual's ability to purchase food products that are available. In short, it means “no money, no food.” Agribusiness incubators work towards helping their clients grow, which contributes directly to job creation and sustainability. As most agribusiness incubators operate in rural areas, there is a direct impact on creating employment opportunities and income generation for the rural poor.
- Utilization – referring to storage, packing and usage of food products for proper nutrition, or value-added food processing. This is another avenue in which agribusiness incubators operate.


The link between agribusiness incubation and food security is hence undeniable. It is the commercial activities, a business-led solution to economic concerns that can truly lead to change. Agribusiness incubators are in the front line of this initiative and the social impact of incubation remains equally as important as its commercial impact.

Modernizing agro-enterprises can be a strong engine for direct and indirect growth, poverty reduction, and food security. At ICRISAT, we reached this realization as early as 2003, with the setting up of the Agri-Science Park @ ICRISAT (now renamed as the Agribusiness and Innovation Platform or AIP) where inclusive growth and development strategy are key.

The three components of AIP – Innovations and Partnerships Program, Agribusiness Incubation (ABI) Program, and NutriPlus Knowledge Program – were so designed to work seamlessly towards harnessing markets and related opportunities. Our goals: to extricate the poor from poverty, hunger, and malnutrition, and to reduce environmental degradation across the dryland tropics.

The ABI Program, in particular, has emerged as a champion in nurturing and incubating several technologies and enterprises, and has become a model for facilitating the creation of competitive agri-business enterprises through technology development and commercialization. ICRISAT through ABI established and is now coordinating the Network of Indian Agri-Business Incubators, with the support of the National Agriculture Innovation Program of the Indian Council of Agricultural Research. ABI has been mentoring 10 agribusiness incubators in the Indian NARS now operating under a co-business incubation model.

We also partnered with IIAM, Mozambique and AREU, Mauritius, as well as with *infoDev's* Agribusiness Community of Practice (CoP) to promote a global agribusiness incubation network. I hope that you will get a chance to interact with our team during your stay here to understand the complementary nature of these



programs. By helping nurture innovations and entrepreneurship in agriculture, ABI has been contributing to the realization of ICRISAT's mission of eliminating poverty and improving livelihoods in the dryland tropics. To date, our incubation program has commercialized 54 agro-technologies and promoted more than 200 agribusiness ventures. For its many exemplary achievements, ABI has won a number of recognitions, one of which is the prestigious National Award for the Best Technology Incubator of the Government of India (GOI).

Incubator managers need to be equipped to deal with a variety of issues while dealing with startups. Just as “1+1 is not equal to 2 in business incubation,” the issues that you face can have multiple dimensions and multiple solutions. This training program package has been designed to help you in drawing up plans, operations and procedures for your own incubator. You will have sessions on incubator models, governance, marketing, field visits, and related topics. I encourage all of you to make the most of this opportunity to interact with our trainers and managers to maximize your learning and experience here.

An inclusive and environmentally sustainable agricultural growth is a prerequisite for a nation's economic development. ICRISAT believes that for the process to be sustainable, there must be a strong convergence strategy to bring together research organizations, civil society and the public and private sectors through mutually beneficial partnerships. It is all about shared challenges, technology exchange, and improved opportunities for communication and collaboration. Business incubators are a key link in this network.

I appreciate UniBRAIN and FARA for their initiative in promoting agribusiness ventures in Africa through value-chain based agribusiness incubators. By partnering with FARA and NAIP, ICRISAT-ABI has become a servant leader globally in the area of handholding a maximum number (16) of agribusiness incubators. I also thank all the trainers who have come here from various parts of the world to help our incubator managers in their journey. This training program is unique in that it will cover every aspect of agri-business incubation. Agri-business specialists will also share valuable learning during investors-startup discussions.

By the end of this training, I am confident that you would have a clearer and better understanding of how agribusiness can provide an impetus towards shifting agriculture from subsistence to market-oriented mode. Let this be the dawn of a new generation of agricultural entrepreneurs and even farmer-entrepreneurs. It is the development of innovative products, processes and concepts by entrepreneurs and their integration into existing agricultural systems that will lead us to an inclusive and sustainable agricultural growth.

We can make this happen! We owe it to the smallholder farmers and the poor people in the developing world!

Thank you!

Agribusiness and food processing: Creating opportunities via partnerships



Honorable Minister for Major Industries, Sugar, Commerce & Export Promotion, Government of Andhra Pradesh; Ms Sangita Reddy, Chairperson, FICCI Andhra Pradesh State Council; Mr S Sivakumar, Programme Chair, Food 360°; Mr J A Chowdary, General Chair, Food 360°; Mr Kali Prasad, Member, Organizing Committee, Food 360°; respected guests, delegates, ladies and gentlemen, good morning!

Today, the world faces “a perfect storm” of big challenges that could lead to widespread food shortages and public unrest over the next few decades. The big challenges include climate change, energy crisis, food crisis, land degradation, loss of biodiversity and population explosion.

According to the World Bank, 44 million people have been forced into

**Special address, FICCI Food 360°
Conference on Agribusiness & Food
Processing, 21 November 2011,
HICC, Hyderabad, Andhra Pradesh,
India.**

extreme poverty by food inflation since June 2010. Going by the latest FAO data, the world's population is projected to reach more than 9 billion in 2050, which will require a 70-100% increase in food production to maintain the same dietary standard we have today.

The past half-decade has seen a growing volatility in food prices with severe impacts on the world's poor. Global food prices rose for the eighth straight month in February of this year, warning that unexpected spikes in oil prices could exacerbate an already precarious situation in food markets.


Agricultural productivity, especially in developing countries, continues to drop, while degraded natural resources and climate change are increasingly affecting food production and prices. The farming community, mostly composed of small and marginal farmers, is the most vulnerable to this situation, getting poor returns for their produce at a time when the cost of cultivation has gone up drastically.

A sustainable, inclusive, resilient, profitable and healthy agricultural sector is considered to be a key factor in a country's efforts to reduce poverty, hunger, malnutrition and environmental degradation.

In India, much of the industrial activity is agro-based, with food processing alone accounting for a big percentage of the total manufacturing industry. We believe, therefore, that the fight against poverty, hunger and malnutrition involves stimulating agro-enterprises to raise rural incomes, and to create opportunities beyond agriculture. And we further believe that more should be done to enhance the policy support and investments for an inclusive agro-enterprises development.

At ICRISAT, we are strongly committed to making a difference through agricultural research-for-development initiatives targeted at four development goals – reducing rural poverty, improving food security, improving nutrition and health, and sustainably managing natural resources.





ICRISAT believes that farming must be done as a business and one of our critical focus areas involves fostering agro-enterprises. We do this by promoting, and initiating key approaches such as public-private partnerships, increased demand for agro inputs and outputs, a conducive business environment, and above all, proactive government policies.

Our emphasis is on smallholder farmers in the dryland tropics and I believe that for India they comprise 65% of the agricultural landscape. These farmers must be key partners in agri-business and food processing ventures. For this we need to expose them to experiential learning processes that will tap into the innate entrepreneurial spirit that exists in the agricultural community.

Modernizing the agro-food system can be a strong engine for direct and indirect growth and poverty reduction in the drylands. It is all about shared challenges, technology exchange, capacity building, and creating opportunities through partnerships.


ICRISAT's new Strategic Plan to 2020 strongly reiterates its commitment to harnessing complementary and purposeful partnerships, through Inclusive Market-Oriented Development, which serves as a dynamic progression from subsistence towards market-oriented agriculture.

This pathway reduces poverty since markets create demand for a wider diversity of higher-value foodstuffs and agro-industrial products. This stimulates agro-enterprises that raise rural incomes and create opportunities beyond agriculture. Smallholder farm families have to be empowered and assisted along this development pathway to lead them from pessimism to prosperity.

At ICRISAT, this seed was sown in 2003, with the setting up of the Agri-Science Park@ICRISAT (now renamed as the Agribusiness and Innovation Platform or AIP) supported by the Government of Andhra Pradesh – where inclusive growth and development strategy is the key. AIP helps achieve the Institute's mandate to help poor farmers in the semi-arid tropics through public-private partnerships.

The Agri-Business Incubation (ABI) Program, one of the components of AIP, has emerged as a champion in nurturing and incubating several technologies and enterprises. It is now a model for facilitating the creation of competitive agri-business enterprises through technology development, commercialization and partnerships with the private sector.

The ABI program was designed to support start-up ventures in the agricultural sector by offering a package of services ranging from technical and scientific backstopping, financial assistance, mentoring, and business plans, to providing infrastructural facilities. Entrepreneurship is encouraged through technology transfer and so far 44 agro-technologies have already been commercialized through public-private partnerships.



Our involvement with the FICCI Food 360° Conference is a milestone in the process of achieving the objectives of our Agribusiness and Innovation Platform, especially that of the NutriPlus Knowledge Program, which has consistently benefited from the support and commitment of the Government of Andhra Pradesh.

NutriPlus works on value addition and post-harvest management in the agri-food sector through innovative processing, product development and food safety enhancement of ICRISAT mandate crops, namely chickpea, pigeonpea, groundnut, sorghum and pearl millet. Recently, NutriPlus has developed nutritious sorghum and millet snacks to offer healthier fast food options to consumers as well as to link poor farmers to the dynamic Indian agro-food industry.

It is important to mention here that recently we launched the ICRISAT South-South Initiative (IS-SI) to boost India-Africa partnerships on agricultural research-for-development. Through this initiative, ICRISAT has further elevated its role as a bridge, broker and catalyst in the global fight against poverty and hunger.

The agri- and food processing industry will be an important partner in the successful implementation of this South-South initiative. I am happy to announce that a 30-member delegation from the Forum for Agricultural Research in Africa (FARA) and officials from various research and educational institutions, industry and other agencies from 5 countries of sub-Saharan Africa will be joining this conference. Their participation here will primarily be aimed at exploring partnerships and future collaborations with Indian counterparts.

We commend FICCI for organizing this international conference. This gives all of us enormous windows of opportunities to interact with the private and public sectors alike, and with the scientific community on how to leverage and augment our interventions further in our quest to bring change in the lives of the forgotten poor.

By the end of this activity, we all hope to have a better understanding and appreciation of how agribusiness and food processing can provide an impetus towards shifting agriculture from subsistence to market-oriented development. This inclusive strategy is what will empower smallholder farmers to grow their way out of poverty, hunger and malnutrition. Our association with FICC in organizing this symposium will definitely create partnership opportunities that will bring us one step ahead in the realization of our Inclusive Market-Oriented Development strategy.

I wish all the participants of this conference great success!

Thank you and a pleasant day to all.

Team ICRISAT: Together we can make things happen




Dear Loyalty awardees and colleagues, good morning!

As we celebrate our 39 years of service, we are gathered here today to honor 166 Loyalty Awardees as we do every year. This is part of ICRISAT's tradition of recognizing your commitment and dedication to the Institute. This is also our way of rewarding the years that you have devoted to ICRISAT.

This annual ceremony means different things to different people. To those who are five years old in the Institute, it serves as a rite of passage, with better days to look forward to. To those who have been here for 10-20 years, it is an acknowledgment of their significant contribution to the Institute.

Message, Loyalty Day, 8 December 2011, ICRISAT-Patancheru, Andhra Pradesh 502 324, India.



And for those who have been around since inception, moulding the Institute and watching it grow from strength to strength, it is a testimony of their faith in the organization and its commitment to the forgotten poor of the dryland tropics of Asia and Africa.

To me personally, it means putting premium on the value of your commitment, loyalty and productivity in achieving ICRISAT's stature and success as the premier global research-for-development institution in the dryland tropics.

I would like to congratulate all of you here who have contributed to our success with your service and devotion. We value your contribution and look forward to greater ideas and initiatives from you ahead.


It's been a year since we pledged to put into action our new Strategic Plan to 2020. Since then, there has been a sea of change in the way we do business. This was evident recently with our success in getting the approval by the Fund Council of our CGIAR Research Programs (CRPs) 3.5 on Grain Legumes and 3.6 on Dryland Cereals. We can finally say that all our hardwork, perseverance and quality science have paid off... and that the voice of the forgotten poor of the dryland tropics of Asia and Africa has now been heard!

Last month, the ICRISAT-led global research team announced the completion of the genome sequencing of pigeonpea which was published in *Nature Biotechnology*. Such an achievement is of vital importance as this will accelerate our breeding efforts. It will have enormous impact on the lives of millions who consider pigeonpea as the "poor people's meat" because of its high protein content.

I can say these new significant developments have demonstrated how we are continuously stepping up our game and persisting in keeping on track despite some odds. We are now on an unrelenting journey together – in the quest for better livelihoods for the smallholder farmers in the dryland tropics of Asia and Africa .

As ICRISAT gets set to celebrate 40 years next year, I can feel a gust of change sweeping the air. ICRISAT's Strategic Plan to 2020 had mapped out a prosperous future for smallholder farmers in the semi-arid tropics. As part of this vision, a Change Management Team (CMT) was created in 2010 to emphasize the imperative for us to embrace new ways of thinking and doing through an inclusive process of cultural change.

What will drive us along our journey together is Cultural Change – one that will occur gradually and will be compelled by five shared values and five key cultural change areas. The shared values are: practicing strategic and systems thinking; caring and showing the way; working for results; respecting everyone; and communicating for understanding.



Meanwhile, the five key cultural change areas are impact orientation; learning and knowledge sharing; innovation; partnership and networking; and gender and diversity. I urge you to internalize, adopt and practice these shared values and key areas.

As we battle the scourges of rising foodgrain prices, hunger and poverty, we need to be innovative in finding solutions. Surmounting climate change, desertification, and the rising perfect storm that I often refer to will not be possible unless we think out of the box, do quality science, and work in tandem with partners to exploit synergies to create impacts.

Inclusive Market-Oriented Development or IMOD, the unifying conceptual framework and roadmap to help end, not only alleviate, poverty and hunger in the dryland tropics, is now ingrained in our science. The concepts of inclusiveness and market-orientation embedded in the framework will propel us towards our aspirations to help halve poverty, hunger, child malnutrition and increase the resilience of tropical dryland farming by 2020. This is an enormous yet an imperative task ahead.

And so once again, TEAM ICRISAT, I encourage each and everyone of you to embrace cultural change in the Institute and live with these values... to bring the growth and development of ICRISAT to a higher level... and to rededicate ourselves to aggressively implement our new strategic plan!

It is the time for us to give our research-for-development initiatives a new impetus, a new direction, to take it along a road where it can feed the world's forgotten poor.

TEAM ICRISAT, I believe we can do it. With a dedicated and loyal team like we have here, together we can make things happen!

Thank you!



Innovate • Grow • Prosper • Feeding the forgotten poor



Dr Gengyun Zhang, President, BGI-Life Sciences, China; distinguished guests, colleagues , ladies and gentlemen, good afternoon!

Today, ICRISAT celebrates 39 years of service. As always, I am very delighted to speak before you on this momentous event. The year 2011 has been a challenging but a most rewarding one. We have overcome big hurdles, and have converted obstacles into opportunities and successes. Now is the chance for us to renew and reinvigorate ICRISAT in a big way.

It's been a year since we pledged to put into action our new Strategic Plan to 2020. Ours is a dynamic strategy of connecting smallholder farmers to markets to enable them to increase their incomes and their resilience – a progression from

**Message, 39th Anniversary
Celebration, Annual Day,
9 December 2011, ICRISAT-
Patancheru, Andhra Pradesh
502 324, India.**

subsistence to market-oriented livelihoods. We call this IMOD – or Inclusive Market-Oriented Development.

Our Plan, which is our road map to the future, commits us to develop our innovations with a systems perspective in mind – looking at how innovations fit together for us to achieve our mission to “reduce poverty, hunger, malnutrition and environmental degradation across the dryland tropics.”


But we also know we cannot do this alone. The science that we do leads us to pursuing partnerships with purpose. We, together with our partners, will elevate the role of smallholder agriculture in feeding a growing population, and in reinventing what we do to raise the plight of the forgotten poor of the drylands.

One year ago, we agreed to think creatively and innovatively, to be open to change, to take risks, to get out of our comfort zones, to build our capacities and partnerships, and not to just do business as usual. We committed to a stronger teamwork, to a systems perspective, and to cultural change towards a learning and sharing organization.

That we are treading the right path is evident this year. I am happy to report to you that ICRISAT is now on top of our game, maintaining a good balance of science and institutional health, financial strength and stability, and staff morale and development.

A testament to the power of partnership with purpose is our success in leading a global alliance of partners and national institutes in Asia and Africa, in getting the approval by the Fund Council of our CGIAR Research Programs (CRPs) 3.5 on Grain Legumes and 3.6 on Dryland Cereals. We can finally say that all our hardwork, perseverance and quality science have paid off.





We are also proud to be the first CGIAR Center to have led a global research team in the completion of the genome sequencing of pigeonpea. Our major partner in this effort was BGI-Shenzhen of China, and we are pleased to have here with us today Dr Gengyun Zhang, President of its Life Sciences Unit. The pigeonpea genome sequence is vital in accelerating breeding efforts, and will have enormous impact on the lives of millions who consider pigeonpea as the “poor people’s meat” because of its high protein content.

Late last year working with partners, we inaugurated the Platform on Translational Research on Transgenic Crops (PTTC) to enhance product development and commercialization of genetically engineered crops. Early this year, we inaugurated the Agribusiness and Innovation Platform building to facilitate the creation of competitive agri-business enterprises through technology development and commercialization.

On a different note, our Institute’s financial health continues to be stable, with increasing and continuous funding base. Our newly approved Fundraising Plan shall guide us in vigorously pursuing bilateral programs and new partnerships. Part of this will be the implementation of the ICRISAT South-South Initiative (IS-SI) to boost India-Africa public-private partnerships on agricultural development.

Relatedly, we are embarking on a vigorous effort towards more strategic targeting of resource mobilization, especially around larger projects, accounting for at least 80% of new funding. Since early this year, an additional US\$ 36 million has been raised from such mega-projects as TL-II, ICRISAT-HOPE and VDS.

The Institute’s sustained financial health through full cost recovery and treasury investments is also on track. Taking all factors into account, an operating surplus of almost US\$ 1 million is estimated at the close of this year. We can proudly say that ICRISAT is now at the top 3 out of 15 CGIAR Centers with the best financial performance.

Cultural change is in full swing, through staff morale and development programs on work-life integration, succession planning, and competency-based Employee Performance & Development Plan (EPaD).

These new significant developments and achievements have demonstrated how we are continuously stepping up our game and persisting in keeping on track despite some odds. We are now on an unrelenting journey together – in the quest for better livelihoods for the smallholder farmers in the dryland tropics.

Colleagues and partners, I hope I was able to convey to you the importance of our mission here in ICRISAT, and the great opportunity that we have in front of us. Let us show once again the great team spirit that we all felt as we put our heads together in strategic planning last year.

Despite our scientific successes in the last 39 years, poverty continues to persist with 185 million poor in dryland Asia and 95 million poor in dryland Africa. Reduction of poverty has now become an overarching goal.

Hence, as the world battles the challenges of rising foodgrain prices, hunger and poverty, we need to be innovative in finding solutions. Surmounting climate change, desertification, and the rising perfect storm that I so often refer to will not be possible unless we think out of the box, do quality science, and work in tandem with partners to exploit synergies to create impacts.

Now is the time to do the extra mile. The whole world counts on us to deliver on our promise. We are all servants here, and it is our privilege to serve this great mission of tackling poverty, hunger and malnutrition in the drylands.

Together with our partners, we in ICRISAT stand ready and driven with conviction to create excellent prospects toward feeding the forgotten poor of the dryland tropics of Asia and Africa!

Thank you, and I wish all of us the very best of success.



Come, share in my pride!*



Dear friends,


It gives me great pleasure to welcome you all to this alumni gathering. I would like to tender my gratitude to each one of you who took out the time to be with us today. It is a wonderful opportunity for you to meet each other, your former colleagues and other staff. It is also a time to familiarize yourself with the developments of your old workplace.

For those who haven't visited the campus since you left, you will see lots of external changes – new facilities that have come up, new initiatives we have taken up. But that's not all that has happened here.

Your institute has come to believe that business as usual will make us redundant.

*Delivered by Dr CLL Gowda, Research Program Director, Grain Legumes, ICRISAT.

**Message, ICRISAT Alumni Meet,
17 December 2011, ICRISAT-
Patancheru, Andhra Pradesh
502 324, India.**



In the process, we thought out of the box to find ways to reduce poverty, hunger, malnutrition and environmental degradation in the dryland tropics of Asia and Africa. We challenged ourselves to be bold and imaginative in building on our past accomplishments and charting a path for the future.

Today, the world faces “a perfect storm” of big challenges that could lead to widespread food shortages and public unrest over the next few decades. The big challenges include climate change, energy crisis, food crisis, land degradation, loss of biodiversity and population explosion.

According to the World Bank, 44 million people have been forced into extreme poverty by food inflation since June 2010. Going by the latest FAO data, the world’s population is projected to reach more than 9 billion in 2050, which will require a 70-100% increase in food production to maintain the same dietary standard we have today.

A living institution like ours strives to make an impact on everything it touches, more so on the lives of smallholder farmers in the dryland tropics. As alumni who truly love and faithfully support this great institution, I know you share my pride in what we are doing and where we plan to go.

We have a new strategy to 2020 which is about harnessing markets to achieve our four mission goals: to elevate the poor out of poverty, hunger, malnutrition and environmental degradation across the dry tropics of the developing world, aided by purposeful partnerships. The strategy is called Inclusive Market-Oriented Development (IMOD).

We have defined six developmental outcomes that we believe will help the poor move along the IMOD path – food sufficiency, intensification, diversification, resilience and two cross-cutting outcomes, namely, nutrition and health and empower women. This is the beginning of our new journey that commits us to develop our innovations with a systems perspective in mind and with partnerships with purpose.

As I speak, I’m sure you will experience a wistful yearning to be part of all this, of ICRISAT’s future. As you will visit the campus and go to familiar nooks that you used to frequent while here, you will have pride that ICRISAT has grown.

I hope you enjoy your time here, meeting up with old friends and exchanging notes.

Have a good day!

About ICRISAT



The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, and 644 million of these are the poorest of the poor. ICRISAT and its partners help empower these poor people to overcome poverty, hunger, malnutrition and a degraded environment through better and more resilient agriculture.

ICRISAT is headquartered in Hyderabad, Andhra Pradesh, India, with two regional hubs and four country offices in sub-Saharan Africa. It belongs to the Consortium of Centers supported by the Consultative Group on International Agricultural Research (CGIAR).

Contact Information

ICRISAT-Patancheru (Headquarters)

Patancheru 502 324
Andhra Pradesh, India
Tel +91 40 30713071
Fax +91 40 30713074
icrisat@cgiar.org

ICRISAT-Liaison Office

CG Centers Block
NASC Complex
Dev Prakash Shastri Marg
New Delhi 110 012, India
Tel +91 11 32472306 to 08
Fax +91 11 25841294

ICRISAT-Nairobi (Regional hub ESA)

PO Box 39063, Nairobi, Kenya
Tel +254 20 7224550
Fax +254 20 7224001
icrisat-nairobi@cgiar.org

ICRISAT-Bamako (Regional hub WCA)

BP 320
Bamako, Mali
Tel +223 20 223375
Fax +223 20 228683
icrisat-w-mali@cgiar.org

ICRISAT-Niamey

BP 12404, Niamey, Niger
(Via Paris)
Tel +227 20722529,
20722725
Fax +227 20734329
icrisatnc@cgiar.org

ICRISAT-Bulawayo

Matopos Research Station
PO Box 776
Bulawayo, Zimbabwe
Tel +263 383 311 to 15
Fax +263 383 307
icrisatbw@cgiar.org

ICRISAT-Lilongwe

Chitedze Agricultural Research Station
PO Box 1096
Lilongwe, Malawi
Tel +265 1 707297/071/067/057
Fax +265 1 707298
icrisat-malawi@cgiar.org

ICRISAT-Maputo

c/o IIAM, Av. das FPLM No 2698
Caixa Postal 1906
Maputo, Mozambique
Tel +258 21 461657
Fax +258 21 461581
icrisatmoz@panintra.com

www.icrisat.org