

Transforming Agricultural Research for Development

Global Author Team¹

Uma Lele
Jules Pretty
Eugene Terry
Eduardo Trigo

with assistance from Maggie Klousia²
and Sambuddha Goswami

The Global Forum for Agricultural Research (GFAR)

Report for the Global Conference on Agricultural Research (GCARD) 2010

¹ This paper by the Global Authors' Team (GAT) was commissioned by the Global Forum on Agricultural Research (GFAR) as an input into the Global Conference on Agricultural Research for Development (GCARD) held in Montpellier, France between March 28th and 31st 2010. It builds on the consultations conducted over nearly a year as part of the GCARD process, in Latin America and the Caribbean, Asia and the Pacific, the North Africa and West Asia, Sub-Saharan Africa, Central Asia and the Caucuses, Western Europe, with additional contributions from China and other Emerging Economies. Some 2000 stakeholders of agricultural research from different sectors participated in these consultations. The paper also draws on the team's analysis of the state of the world agricultural research undertaken by or for the benefit of developing countries and the rapidly changing international context in which the research is conducted. The Team reviewed nearly 300 recent and historical documents, drew on their own collective experience of nearly 35 years each in different parts of the world, and benefited from perspectives and comments on the earlier draft from the authors of Regional Papers, leaders of international, regional and national research systems, colleagues in IFAD, FAO, GFAR, the CGIAR, the World Bank, IDS and many others. Outcomes of the GCARD conference are summarized in the synthesis paper and the Road Map; both will be discussed at the Steering Committee meeting held on September 28th and 29th, 2010. The views expressed in the paper are those of the authors and do not necessarily reflect the views of the GFAR Steering Committee, its constituents or the donors who have financed GFAR and the GCARD process. Comments are welcome from all readers.

² We are grateful to GFAR for financing the support of Maggie Klousia. Uma Lele contributed the time of Sambuddha Goswami

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List of Acronyms

AARINENA	Association of Agricultural Research Institutions in the Near East and North Africa
AATF	African Agricultural Technology Foundation
ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
AERC	African Economic Research Consortium
AfDB	African Development Bank
AFN	Asia Forest Network
AGRA	Alliance for a Green Revolution in Africa
AKIS	Agricultural Knowledge and Information System
APAARI	Asia-Pacific Association of Agricultural Research Institutions
APAFRI	Asia-Pacific Association of Forestry Research Institutes
APSA	Asia-Pacific Seed Association
ARBN	Asian Rice Biotechnology Network
ARVC	Asian Vegetable Research Center
ASPNET	Asia and Pacific Regional Network of the International Network for Improvement of Bananas and Plantains
ASTI	Agricultural Science and Technology Indicators
BARD	Binational Agricultural Research and Development fund
BASIC	Building Africa's Scientific and Institutional Capacity
BRIC	Brazil, Russia, India and China
CAADP	Comprehensive Africa Agricultural Development Program
CAAS	Chinese Academy of Agricultural Sciences
CAC	Central Asia and the Caucasus
CACAARI	Central Asia and the Caucasus Association of Agricultural Research Institutions
CARDI	Caribbean Agricultural Research and Development Institute
CATIE	Agronomic Center for Research and Education in the Tropics
CCAP	Center for Chinese Agricultural Policy
CDD	Community Driven Development
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIDA	Canadian International Development Agency
CIFSRF	Canadian International Food Security Research Fund
CIMMYT	International Maize and Wheat Improvement Center
CIRAD	France and the Centre International de Recherches Agricoles pour le Developpement
CLAN	Cereals and Legumes Asia Network
COGENT	International Coconut Genetic Resources Network
COMESA	Common Market for Eastern and Southern Africa
CONICET	National Scientific and Technical Research Council
CRPs	CGIAR Research Programs
CRSP	Collaborative Research Support Program
CSO	civil society organizations
CSREES	Cooperative State Research, Education and Extension Service
DFID	Department for International Development
DONATA	Dissemination of New Agricultural Technologies in Africa
DPL	Development Policy Loans
EAP	East Asia Pacific
ECART	European Consortium for Agricultural Research in the Tropics
ECOWAS	Economic Community of West African States
EFARD	European Forum on Agricultural Research for Development

EMBRAPA	Brazilian Agricultural Research Corporation
EPMR	External Program and Management Review
ERA-ARD	Agricultural Research for Development Dimension of the European Research Area
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
FFS	farmer field school
FONTAGRO	Regional Fund for Agricultural Technology
FORAGRO	Forum of the Americas on Agricultural Research and Technology Development FDI Foreign Direct investment
GAT	Global author team
GCARD	Global Conference on Agricultural Research for Development
GFAR	Global Forum on Agricultural Research
GHG	Greenhouse Gas
ICAR	Indian Agricultural Research Council
ICRISAT	The International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IEG	Independent Evaluation Group (of the World Bank)
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Institute
IICA	Inter-American Institute for Cooperation on Agriculture
INGER	International Network for Genetic Evaluation of Rice
INIFAP	National Institute for Forestry, Agricultural, and Animal Husbandry Research
INTA	National Institute of Agricultural Technology
IP	indigenous peoples
IPCC	Intergovernmental Panel on Climate Change
IRRI	International Rice Research Institute
IWMI	International Water Management Institute
JIRCAS	Japanese International Research Center for Agricultural Sciences
KARI	Kenya Agricultural Research Institute
KHDP	Kenya Horticulture Development Program
LAC	Latin America and the Caribbean
MDG	Millennium Development Goal
MENA	Middle East and North Africa
MP	Mega Programs
MSSRF	M.S. Swaminathan Research Foundation
MTA	Material Transfer Agreement
NAADS	National Agricultural Advisory Development Service
NACA	Network of Aquaculture Centers in Asia-Pacific
NARES	National Agricultural Research, Education and Extension Systems
NARI	National Agricultural Research Institution
NARO	National Agricultural Research Organization
NARS	National Agricultural Research System
NGO	non-governmental organization
NIFA	National Institute for Food and Agriculture
NRM	Natural Resource Management
NSF	network support functions
OECD	Organization for Economic Cooperation and Development
PAEPARD	Partnership for Africa-European Partnerships for Agricultural Research and Development
PO	people's organization
PM	People's movements

PPP	Public-Private Partnership
PROCI	Cooperative Research and Technology Transfer Program
PROCISUR	Cooperative Program for Agricultural Research in the Southern Cone
PRRM	Philippine Rural Reconstruction Movement
R&D	Research and Development
RAILS	Regional Agricultural Information and Learning Systems
RAIS	Regional Agricultural Information System
REDD	Reduced Deforestation and Degradation
S&T	Science & Technology
SA	South Asia
SADC	Southern African Development Community
SCARDA	Strengthening Capacity for Agricultural Research and Development in Africa
SEANAFE	Southeast Asian Network for Agroforestry Education
SEASAKNet	Southeast Asian Sustainable Agriculture Knowledge Network
SEWA	Self-Employed Women's Association
SICTA	Central American Integration System for Agricultural Technology
SRF	Strategic Results Framework
SRO	sub-regional organization
SSA	Sub-Saharan Africa
TAC	Technical Advisory Committee
TAR4D	Transforming Agricultural Research for Development
ToT	Transfer of Technology
USAID	the United States Agency for International Development
USDA	United States Department of Agriculture
UTFANET	Underutilized Tropical Fruits of Asia Network
WALHI	Indonesian Forum for the Environment
WEMA	Water Efficient Maize for Africa
WFP	World Food Program (of the United Nations)

About the Authors

Dr. Uma Lele is a former Senior Advisor to the World Bank, and has served as Graduate Research Professor and Director of International Studies at the University of Florida, as the Director of the Global Development Initiative of the Carter Centre and the Carnegie Endowment, as a member of the Technical Advisory Committee of the CGIAR, and on the Board of Directors of the Center for Forestry Research (CIFOR). She served as the Co-Chair (with Professor Shen Gao Feng) of the China Council for International Cooperation on Environment and Development Taskforce on Forests and Grasslands, as the Co-chair (with Professor Ronnie Coffman) of the GREAN (Global Research on the Environmental and Agricultural Nexus) Initiative. She was panel member of the Independent Evaluation of FAO. She is Fellow of the American Association of Agricultural and Applied Economics and of India's National Academy of Agricultural Sciences. She serves on the boards of the M.S. Swaminathan Research Foundation (Chennai, India), the Institute of Development Studies (Sussex, U.K), and the Technical Advisory Panel of the Global Water Partnership and other international advisory panels.

Professor Jules Pretty OBE is Professor of Environment and Society at the University of Essex, UK. His 16 books include *This Luminous Coast* (2010), *The Earth Only Endures* (2007), and *Agri-Culture* (2002). He is a Fellow of the Society of Biology and the Royal Society of Arts, former Deputy-Chair of the government's Advisory Committee on Releases to the Environment (ACRE), and has served on advisory committees for a number of government departments. He received a 1997 international award from the Indian Ecological Society, was appointed A D White Professor-at-Large by Cornell University from 2001-2007, and is Chief Editor of the *International Journal of Agricultural Sustainability*. He received an OBE in 2006 for services to sustainable agriculture, and an honorary degree from Ohio State University in 2009.

Dr. Eugene Terry is the former Director General Africa Rice Center/WARDA and the former Chair Board of Trustees World Agroforestry Center/ICRAF. He is currently a trustee and the Program Committee Chair for the World Vegetable Centre, the Chair of the Advisory Board for the West Africa Centre for Crop Improvement, and a trustee at the Syngenta Foundation for Sustainable Agriculture. He was also the Founding Director and Board Member for the African Agricultural Technology Foundation (AATF). He is an Honorary Professor for the Department of Biochemistry, Microbiology, Genetics and Plant Pathology, and is part of the faculty of Science and Agriculture at the University of KwaZulu -Natal, Pietermaritzburg, South Africa. He received his PhD in Plant Pathology from the University of Illinois, Urbana-Champaign, his M.Sc and B.Sc from McGill University, Montreal, Canada.

Dr. Eduardo J. Trigo is the Director of Grupo CEO and Scientific Advisor for International Relations at the Ministry of Science, Technology and Innovation of Argentina. In the past he has served as Director of Science and Technology at the Inter-American Institute for Cooperation on Agriculture, (IICA) and as Director of Research at the International Service for National Agricultural Research, (ISNAR). His main area of work is science and technology policy and organization, with emphasis in biotechnology applications to the agricultural and food sector, where he has published extensively.

Preface: Transforming Agricultural Research for Development (TAR4D), A Global Consultants' Report

This Global Conference on Agricultural Research for Development (GCARD) 2010 is the first in a series of bi-annual global conferences designed to transform the current system of agricultural research. The aim is to convert the fragmented and multi-sectoral institutional set up into a coherent whole so as to achieve more rapid, scaled-up and sustainable impacts on food security, poverty and the environment. Poor households in the developing world face multiple insecurities with regard to food, energy, water and livelihoods. There should be enough knowledge and resources available or that can be mobilized globally to tackle these problems. However, as noted in the FAO 2009 Expert Meeting on How to feed the world in 2050, we may know how to meet these challenges, but we doubt the ability of our institutions to deliver the required changes in practice. The GCARDs provide a process for step-wise action and chance to meet these daunting development challenges.

Central to the strategic objectives of GCARD is the need more effectively to:

1. Identify the needs and demands of regional and national partners in the public, private, educational and civil society sectors in developing countries;
2. Strengthen the responsiveness of the international and national agricultural research system to those needs and priorities;
3. Increase the mutual accountability of the stakeholders to achieve broader and more sustained development impacts.

Strategically, GCARD 2010 will be a key milestone in the reforms underway in both the Global Forum on Agricultural Research (GFAR) and the Consultative Group on International Agricultural Research (CGIAR). This will also be the start of the Transformation of the Agricultural Research for Development (TAR4D) process. This is the principle theme of this report. The global team of authors (GAT) was charged with the task of identifying the needs and priorities of developing countries for more inclusive and environmentally-sustainable development pathways, and of setting out the partnerships, mechanisms, innovative pathways and investments needed to translate the products of agricultural research into larger and quicker development impacts.

The GFAR reforms are providing a new basis for collective action for change from all stakeholders. This paper offers ways in which the hope and aspirations that the voices of the poor will be heard may be translated into the planning, implementation and assessments of investments in agriculture, with agricultural research playing a more active role in development that will be both more inclusive and more sustainable. Concurrently, the CGIAR is implementing a change management process that is revitalizing the system to achieve greater collective impact, leading to a new vision and strategic direction for the CGIAR. The reforms are designed to increase openness and cultivate dynamic partnerships, and ensure that the CGIAR is financially-strengthened, with a results-based culture, simplified governance, and clarified accountabilities with clear and distinct roles for both investors and implementers.

Significantly, these reforms are being implemented at a time when the G-8 has declared in its L'Aquila Statement on Food Security that it directly supports the role of the Global Forum for Agricultural Research (GFAR) and its strengthening to ensure effective and inclusive stakeholder participation (e.g. farmers' organizations, civil society, private sector) and strengthened ownership of national and regional research systems. The G8 stated *"we support the fundamental reform processes underway in the global agricultural research system through the Global Forum on Agricultural Research."*

This report presents an analysis of the overarching global food security, poverty and environmental issues that highlight the dimensions of demand and supply, and the interconnectedness of global markets within and across sectors in the context of new threats of climate change, energy shortages, and global pressures on markets and economies. This report emphasizes the core importance of science, and its contributions to the high rates of return to investments in R&D, albeit with a broader view of what constitutes science and its implications for co-creation and application of knowledge. It recognizes the potential role of the CGIAR's new focus on a results-based framework and large-scale programs in the context of the changed location and size of poverty and food security, and the immediate implications of an outcome focus for agricultural research and development. The report describes the landscape of actors and activities, as well as the diversity and resource endowments of the institutions at the international, regional and national levels related to agricultural research for development.

The team has built its proposal on TR4D on the regional consultation process and the CGIAR's reform process. In elaborating the Road Map and the Action Plan for TAR4D, the Team determined that these represent an initial stage for a phased set of monitorable indicators of progress spreading over the next 4 to 6 years. These interventions are characterized by their focus on researchable development needs, rapid generation of innovations and spread of knowledge and technologies through improved access and uptake services, and effective use of collective capacities. The ultimate goal of this proposal is to achieve significant increases in human, institutional and financial resources and capacities commensurate with the huge transformation challenges.

The team has also identified the strategic prerequisites for achieving stronger functional linkages with other development actors so as to radically alter the architecture of what is presently a fragmented global system of research and development. This report and the details of the Road Map are presented for consideration and take-up by the stakeholders from public, private and civil society sectors, such that each plays an effective role in these transformative changes. The Team recognizes the significant opportunity presented by the G8 statement of support for the revitalization of AR4D, and accordingly strongly recommends full engagement at the highest levels of international organizations and national governments including at G20 meetings through global monitoring and reporting of progress towards a transformed and a more effective AR4D which will achieve sustainable food security for the poor.

Signed – The Global Author Team (in alphabetical order)

Uma Lele
Jules Pretty
Eugene Terry
Eduardo Trigo

Executive Summary for GAT Report

What change is needed, why and how?

Many of the world's poor people make a living from the land. Pressure on land, water, fuelwood and genetic resources has increased in the regions which contain the greatest poverty. It is likely to get worse if urgent action is not forthcoming. Compounding these problems, the poorest of the poor tend to live in remote inaccessible rural areas. Agriculture (to mean crops, livestock, fisheries, forestry, fruits, vegetables among others) tends to be only one of several strategies the poor deploy to diversify their livelihood to reduce risks. But this means that effective pro-poor, pro-women and pro-environmental systems for agricultural knowledge, technology generation, systems of delivery and knowledge sharing take place in multiple directions. Such systems are needed on a large scale for the development of whole societies and indeed for more inclusive and sustainable global development, but the ability to replicate or scale up is constrained by the heterogeneity of conditions.

These changes must occur starting at the local, national and regional levels with external actors playing a facilitative role. External efforts can neither substitute for nor replace the complex and routine strategizing, planning, implementing, problem-solving and learning needed on multiple fronts which only national institutions and actors can and must do. They also benefit from institutional memory which intermittent external actors lack. Thus local, national and regional entities can and must take the lead with the first and successive planning of Global Conferences on Agricultural Research for Development (GCARDs) meant to facilitate their processes.

Important insights for this paper of the Global Authors' Team (GAT) came from a major global consultation process undertaken over nearly a year in all major developing regions of the world led by regional associations for GCARD. Regional Research Fora APAARI (Asia-Pacific), FORAGRO (Latin America and Caribbean), FARA (Sub-Saharan Africa), AARINENA (W. Asia and N. Africa), CACAARI (Central Asia and Caucasus), EFARD (Europe), and China have each established networks and developed priorities that emerge from and focus on concerns within regions. In addition, there is also a great diversity of associations related to agricultural research as well as strong discipline or subject-based networks.

More inclusive than ever before, but understandably by no means perfect, the regional consultations involved some 2000 stakeholders. Products from these consultations and comments on an earlier GAT draft paper from some of the regional *agricultural* research associations note a number of successes in regional cooperation in research among themselves and in partnership with the CGIAR and others but stress that the developing world's agricultural research systems are currently insufficiently developmental-oriented. Research organizations have generally not been good at integrating the needs and priorities of the poor in the work of researchers. Farmers have difficulty accessing new technologies and innovations and many lack organized networks. There is a disconnect between research and extension systems as well as between researchers and policy makers. Many research systems are under-resourced, and even those that are well-endowed tend not to be sufficiently connected with the broader processes of development. These communications also stress that a change is needed in the incentive structures in the national and international research community to deliver impacts for the poor. They emphasize that systems need to be more accountable to their beneficiaries rather than focus on the outcomes of scientific achievements alone. They also note that there are few incentives for national and international research systems to work more closely with policy makers or with farmers' organizations, or to invest in coordination, knowledge management and communication. Their constituent institutions often have insufficient connection with, and accountability to, their desired beneficiaries. The results of these consultations,

if they are widely subscribed to by all regions, have served as an important *partial* diagnostic needed to transform the currently fragmented agricultural research system for development into a more cohesive one (see Box A).

Agricultural Research Systems must also become more agile and adaptable in responding to the fast changing external environment. In an age of globalization, the poorest are hit the hardest by external shocks as the food and the financial crisis of 2007 and 2008 have well-established. Integration of the global markets across sectors has occurred at a speed unanticipated by most. Climate change is projected to most affect the regions with the most poverty. Energy, climate change and market integration are likely to be important drivers of the future agendas for the poor, though others may add to this list. At the same time, cell phones and other technologies are making a revolution in the ability of the poor to access information transforming the ways in which they are or can be reached.

There are additional obstacles as well as opportunities that countries and regions will need to take into account. These are addressed in the main body of this report, and include:

- The poorest people tend to be women and children, who have even less voice than poor men but again through decentralization rapid changes are taking place in representing their interests.
- Our understanding of the microeconomics of households living in poverty is however weak at best and fragmented by sectors (e.g. agriculture, health, forestry) at most. It needs to be strengthened.
- National and regional organizations are coming into their own and yet have several weaknesses of their own including inadequate representation of women, civil society, the private sector and the environmental groups. They focus mainly on crops. They will need substantial strengthening to improve priorities and resolve differences on behalf of all stakeholders.
- Gender concerns are not always on the forefront of agricultural research systems in all developing regions but are strong in some developing countries and in the donor community at large.
- Civil society organizations are highly-developed in some parts of the developing world, and already have shown they can have substantial impacts on agricultural and rural policies and development in important ways. But these voices are still nascent in many part of the developing world.
- The lack of effective extension systems hinders the effectiveness of agricultural development that helps the poor and benefits the environment.
- Neither developing countries nor donors have kept their promises to meet targets on allocations of national budgets or of aid amounts to food and agriculture. On the other hand there are many examples of misallocation of funds to areas of activity with limited if any benefits to the poor. Overall official aid as well as its share to agriculture and infrastructure has been declining. In some regions of the world, net aid flows are already negative and even in those regions with the largest number of poor overall aid and shares to agriculture and infrastructure have declined.
- More aid goes to emergencies than for long-term agricultural or rural development.
- Political obstacles to cooperation *in all parts of the world* are vital because they entail vested interests and competition for scarce resources, whether for energy, water, finances or institutional reforms.
- Resistance to policy and institutional reforms tends to be great even in the face of a fast changing reality which calls for change.
- And yet if TAR4D focused only on poverty reduction it will cover only subsectors of two parts of the developing world where poverty is concentrated. The focus on poverty is necessary and urgent but not sufficient either for a GCARD or for achieving impacts on reducing

- poverty. It will systematically overlook the opportunities to borrow ideas, technologies and approaches from other sectors and other parts of the world.
- Emerging countries are becoming powerhouses.
 - Science and technology are advancing at remarkable speed.
 - Emerging economies and developed countries and their regional groupings, e.g. the EU and the US have expressed enthusiasm to mobilize their expertise for global cooperation under a new GCARD umbrella.
 - The global and regional *institutional capacities*, including that of GFAR, to harness these tremendous new opportunities remains low at present. They can, though, be built.
 - All regions are demanding and must have an opportunity to benefit from these possibilities.

These are no minor threats or obstacles but they also provide huge opportunities. They offer all the reasons why significant steps need to be taken now if a true Transformed Global Agricultural Research for Development System is to evolve. Even at best it will take more time to achieve than the changes in the environment require. It means mobilizing, reorienting, strengthening and bringing coherence to a currently fragmented system to help the poor escape poverty until they can effectively participate in the overall agricultural and economic growth processes underway elsewhere in their countries and in the world.

Box A. What Does A Transformed Agricultural Research for Development Mean?

A Transformed Agricultural research for development is one that helps to achieve sustainable food and income security for all agricultural producers and consumers and particularly for the resource poor households, whether they are in rural or urban areas. *Sustainable* agricultural intensification means producing more food and agricultural products from the same overall resources (e.g. land, labor and water) *while reducing the negative environmental impacts and at the same time increasing contributions to natural capital and the flow of environmental services*. Sustainable agricultural systems cannot be defined by silver bullets, i.e. acceptability of any particular technology or practice. There are no standard blueprints.

AR4D is research that:

- Operates on the principles of subsidiarity: activities are best conducted at the level at which there are the responsibilities and accountabilities, and where research results need to be applied;
- Builds its priorities from the bottom-up through socially-inclusive processes involving the poor and the disenfranchised;
- Brings into play a diversity of approaches, technologies and practices, including combinations of traditional knowledge, conventional technologies, agro-ecological methods and modern biotechnology;
- Exploits and integrates participatory approaches with scientific and experimental methods;
- Ensures results-based management effectively integrated with innovative science and development;
- Even at the local level routinely devises methods to assess progress of implementation of processes through systematic independent monitoring and evaluation;
- Maintains its identity and operation separate from development actors though seeks effective partnership strategies and linkages to all other relevant agricultural and rural development investments and policies at all levels;
- AR4D is *not* development but contributes to it through greater sensitivity, active partnerships, vigorous commitment to building the capacity of partners including particularly the beneficiaries and increased accountability for more and better results on all fronts: poverty reduction, productivity growth and environmental sustainability. It makes trade-offs explicit and helps decision-makers choose better options.

Science for Sustainable Intensification

Science focuses on understanding and improving crop and animal genotypes by all methods as well as on agro-ecological management, in addition to improving the capacities of people and their institutions to deliver inputs, manage systems, and distribute and use outputs. There is a need to creatively link farmer's

own innovation systems with those from science to build mutual understanding and trust and so better benefit from both. Participatory and interdisciplinary approaches to research on community management of natural resources, that combine advanced science with local adaptation, are needed but will require vigorous quantitative and qualitative methodologies for outcomes to be *replicable at scale*. They will be highly skill-intensive.

At the same time, we need to harness the best of advanced innovation in a range of scientific and social science disciplines, from telecommunications to micro-insurance, molecular biology to meteorology as all can provide valuable tools for agriculture, food and rural development.

Sustainable intensification emphasizes not only technology -related research but also other types of research aimed at triggering policy and institutional changes. It also needs the development of enabling institutional environments for the local and global communities to build on strengths, address weaknesses, exploit opportunities and remove threats to achieving sustainable development.

Therefore TAR4D means producing more and better research aimed at delivering credible facts, ideas, concepts and a menu of options for the benefit of the poor including current and alternative future scenarios, drawing on history, culture and contemporary developments in a wide range of areas, in a form which can help identify values, perceptions, needs, constraints and bottlenecks which all stakeholders either possess, face or can benefit from.

Outputs can help design, monitor and evaluate interventions undertaken by multiplicity of actors in many sectors *at all levels*. It can help to develop appropriate mechanisms, partnerships and innovation pathways that can translate research products into development impacts *at scale*, from the local to global, to improve development outcomes and impacts globally.

Cutting Hunger and Poverty: Pathways from Agricultural Research to Development Impacts

Hunger threatens development in many ways: resulting in caloric and nutrient deficiency, increasing susceptibility to disease, encouraging child labor, withdrawal from schooling particularly of girls, out-migration, destitution, prostitution and conflict.

Where is most hunger and poverty?

South Asia and Africa are the battlegrounds for poverty reduction. Yet poverty reduction should be at the centre stage throughout all publicly-funded agricultural research. Different measures show that between 1 billion to 1.5 billion people still lack basic food security or live in poverty. Regardless of which measure is used almost all (95 to 97%) of the food insecure and poor now live in two regions of the world, Asia and Sub-Saharan Africa, about two-thirds in Asia and a third in Africa. South Asia and Sub-Saharan Africa rank the highest in IFPRI's integrated measure of hunger, child development and child mortality. IFPRI has called the situation 'alarming'.

This situation of poverty is clearly avoidable in the modern world. Prospects for reducing poverty quickly are greater in South Asia than in Africa. South Asia has several advantages which Africa tends to lack. The two large countries, India and Bangladesh, have had sustained and rapid economic growth, substantial scientific and other human and institutional capacities, a diversity among institutions including civil society, private sector and women's organizations, a free and lively press, and a greater density of physical infrastructure and access to markets. Yet massive poverty remains alongside rapid economic growth due to policy and institutional failures, despite a number of successes. Besides, South Asia and particularly India ranks high among developing countries in making substantial increases in the allocation of funds to agricultural research. If there is the willingness to confront tough internal policy and institutional constraints and active partnerships internally with programs that are more successful and externally with regional, emerging,

international and advanced countries , then poverty can be substantially reduced in a decade to a decade and a half.

The challenges are far greater in Africa in each of these respects. Africa faces greater biotic and a biotic stresses, has lower human and social capital in the form of a complex network of institutions, particularly in small countries. It has less physical infrastructure and market connectivity but now greater commitment to agriculture than before and therefore needs more help particularly in the expansion of human capital and institutions from the external community. The emerging countries of China, India and Brazil are already partnering and are in a stronger position to help Africa than Europe or North America because their systems are closer to Africa's. A global umbrella would help them and other large and middle income countries (such as Mexico, Indonesia) as well as private foundations such as the Bill and Melinda Gates, Rockefeller and Syngenta Foundations for greater South-South and North-South cooperation.

Pathways from Agricultural Research to Productivity, Production, Low Food Prices and Reduced Hunger

Agricultural research has been remarkably successful in spreading new technologies among millions of farmers of all sizes in the past half century including particularly small farmers. When and where research has been accompanied by enabling policies, investments and institutions, it has helped triple aggregate world food production; per capita production is up by 30%. Most, but not all, production increases have come on existing lands. Application of knowledge generated by agricultural research has increased employment and incomes for the landless and near landless in many countries while bringing real prices of food down until 2007.

Low prices benefit poor consuming households. Low prices do also help poor rural communities, as many men and women are now near marginal farmers, herders, fisherfolk, or forest-dwellers and depend on the market for food much like urban consumers. They also spend a far larger share of their meager income on food than do the middle classes. The benefit from farm and non-farm employment created from increased production and productivity. These "backward and forward growth linkages", have regularly proven to be far larger when smallholders or marginal farmers are the focus of development than when interventions focus on the large-scale operators. Clearly these benefits must be extended to the poorest producers and consumers as quickly as possible

Past growth has not done enough to reduce poverty, but even that growth has now stalled, and come at substantial environmental costs with profound implications for the future.

While research is essential, it alone cannot solve the problems of hunger, the plight of poor women and undernourished children, even in partnership with others. Strong political will and complementary enabling policy and institutional conditions are needed for research and service delivery providers to be accountable to the poor. This is well-proven by research on child feeding programs and numerous other small farm production programs and projects in South Asia. Appropriately strengthened national and regional stakeholders together through increased information and accountability measures of the media, the bureaucracy and the legal system are in the best position to address issues of more and better quality expenditures on the poor.

At the same time AR4D cannot afford to overlook considerations of national food security and international competitiveness of agriculture. AR4D is essential to increase supplies, to meet urban and international demand, limit food price increases, and thereby maintain overall political stability where it exists, help secure it where it does not, and strengthen it in many newly democratized countries.

Research can also no longer ignore the pressing issues of climate change. It must therefore actively contribute to the issue of climate change mitigation and adaptation.

All regional priorities established through the GCARD process have in common calls for research on climate change, food security and management of land, water and natural resources while increasing agricultural productivity. Subsets have highlighted major cereals, forestry, fisheries, access to markets and extension. Overall however given the heterogeneity of the needs, priorities and constraints identified, beyond, noting that there is considerable scope for convergence, for example, between what the regions need and the CGIAR may offer specific programs of cooperation must clearly be worked out by appropriate entities with responsibilities and accountabilities in the regions, with the CGIAR and other partners.

A global transformation will require recognition of the substantially broader multi-institutional architecture of scientific research and development that must now span and evolve worldwide creating a market place for ideas, technologies and approaches. This includes the role of small and large scale commercial agriculture, value chains and international trade, finance and other global scientific and environmental conditions, and attention to commodity research among other things. It will need to be inclusive of both women and the needs of small farmers and families, as well as of those farmers who are already in the market place. It will require representation of the poor in various fora designed to develop solutions.

The CGIAR Reform

The CGIAR has played a critical role in helping to achieve food security mainly through improved germplasm research, in populous countries in Asia, once dangerously dependent on large amounts of food aid, as well as in much of Latin America and the Middle East. Its success in research on cassava has improved food security for millions poor farmers and consumers in Africa. But for well over a decade now the CGIAR research has suffered from increased share of short-term funding tied to specific agendas, overlapping mandates and a lack of focus. The impacts of the CGIAR have slowed. It comprises 4% to 5% of the total public expenditure on agricultural research worldwide and faces competing demands on its resources. Since the reforms, the CGIAR's new business model has been designed to address food security at large scale and in a more outcome-focused way, with a clearer focus on people, results, and efficiency. The new emphasis calls for collective action through integrated thematic research, focused on distinct development objectives. It aims to make use of the value of international research alongside national programs and commitments to deliver research outputs on a scale and value sufficient to achieve impacts on poverty among millions of smallholder farmers and poor urban consumers. A new Fund is expected to harmonize donor contributions to support the CGIAR's 15 research centers.

The total global investment in public sector agricultural research is nearly 20 times larger than the CGIAR's, more than half of it in the developing regions. The rest is in advanced countries. The CGIAR and the developing countries need to work more proactively with the remaining 95% to 96% to achieve large scale global impacts. Building on past successful partnerships shedding ones which are not working, the new reformed CGIAR can work systematically, building on the past. At the same time there are numerous examples of developing countries and their regional fora establishing effective research and technology partnerships.

International research has distinct roles and values and large countries have very different roles and capacities compared to small ones. These need to be harnessed better in support of national development, using its considerable assets which include a record of achievement and credibility, a

vast collection of germplasm, its coordinating role, functional brokerage between advanced science and its application for wider benefit of global good. It is clear that in the areas of natural resource management, policy and social science research the CGIAR must actively encourage developing countries to take the lead, decentralize research to systems in developing countries that are capable and committed to producing local and regional public goods research in joint partnership with advanced country research institutions in the public and the private sector while monitoring and holding each other accountable for results. **The CGIAR's Strategic Results Framework (still a work in progress at the time of publication of this report) notes that public agricultural R and D for developing countries would need to increase from the current \$5.1 billion to \$16.4 billion by 2025 – of which the \$1.6 billion would need to be the CGIAR element to achieve its projected increases in production. This report contends that it is the minimum amount necessary. Developing countries' agricultural research responsibilities extend well beyond the CGIAR's mandated activities.**

Harnessing resources for increasing effectiveness of policies, institutions, technology generation and dissemination in developing countries (using the considerable expertise in the CGIAR, ARIs, Emerging Economies and the private sector) for worldwide poverty reduction should be a major focus of subsequent GCARDs, much as it was of GCARD 2010.

The CGIAR's new research agenda is also at a formative stage and is meant to be focused on limited number of unifying themes that appear in broad alignment with those identified from each region, namely (i) Agricultural systems for the poor and vulnerable, (ii) Enabling agricultural incomes for the poor, (iii) Optimizing productivity of global food security crops, (iv) Agriculture, nutrition and health, (v) Water, soils and ecosystems, (vi) Forests and trees, (vii) Climate change and agriculture (viii) Agricultural biodiversity. These research priorities were also evolving at the time of publication of this report. The CGIAR also proposes creating two platforms as catalysts for the wider development of research and actions on Gender, and Capacity-Strengthening.

These need to build on the strengths and weaknesses of the past partnerships, including following the principles of increased inclusivity and good practice of shared objectives, finances, a governance structure, clear roles, responsibilities and accountabilities and rigorous and appropriate monitoring and evaluation of results. Much of the research on gender should take place in and by developing countries as a way of fostering greater commitment to the issues of gender inclusiveness.

Currently many countries are experiencing downward pressure on economies. Nevertheless **this calls for increased investments in agricultural research, extension and development.** Barring China and India, most countries have neglected to invest in their agriculture and even those systems acknowledge that they face challenges in addressing issues of the environment and poverty. Given the time lags of 7 to 20 years from research to impact in the field, **increased funding to agricultural research to 1 % or 1.5 % of agricultural GDP is certain to be a recommendation for GCARD 2012 and should be systematically monitored and outcomes disseminated.**

A very substantial amount of this investment must go into human capacity building and to modernize research management and incentive systems for researchers to develop pro-poor programs in as many developing countries that national and regional organizations believe they can to increase their relevance and accountability to the poor clients which regional research stakeholders have stressed they need.

Many can learn from the experiences of emerging economies and OECD countries and GFAR should have an active role in fostering such cross learning and good practice.

It is impractical to set investment targets for overall agricultural development at GCARD 2010; Sub-Saharan African countries have adopted the target levels of investment but have not met them. In

other cases investment has been misallocated and requirements vary depending on the resource base and most governments have not followed through on their promises. Yet there is need for massive reforms and investments to improve delivery conditions and systems including the need for secure land rights, seed and credit, revival of extension systems, engagement of CSOs, development of policy capacity, promotion of rural infrastructure and information technology, and establishment of appropriate financial institutions and increased attention in measuring and tracking performance and accountability. All require attention and investments estimated by FAO to be in the billions of dollars.

Avoiding paralysis by further analysis is not an option. Moving to concrete actions with each individual and entity taking responsibility is the only option. The Global Conference on Agricultural Research for Development 2010, the first in a series of biennial global conferences, is designed to *initiate* and report progress on this transformation. Successive cycles of collective action will determine if rapid cross-learning and progress is taking place and if more transparent mutual accountability among all stakeholders is developing.

In summary, the Global Author Team of GFAR to the GCARD **acknowledges** the substantial contribution of agricultural research leaders and institutions to development, **recognizes** their role in the removal of persistent food poverty of many rural and urban people across both developing and developed countries, **notes** the unpredictable global economic environment resulting from rapid global integration which most affects the poor, **accepts** the emergent and uncertain challenges of climate change and related pressures on environmental services, **argues** that agricultural research for development must be transformed, **calls** for more financial investment to foster rapid and broad-based innovation, and **sets out** a road map for the immediate future.

Continued work on the Road Map from GCARD 2010 to GCARD 2012

The Global Author Team (GAT) provided this draft version (below) of a Montpellier Action Plan, or Road Map, in their original paper submitted to GCARD 2010 conference attendees; in the concluding session of the conference, a revised version (based on conference discussions) was presented and debated by the audience. Since the conference, the GAT, in collaboration with conference participants and stakeholders, has continued to develop a revised Road Map that reflects the themes, issues, and goals outlined during GCARD 2010; the revised version has been submitted to GFAR and will undergo further developments before being issued. The greatest challenge is to operationalize the Road Map as soon as possible since GCARD 2012 is less than two years away and there is urgent need to report a few genuine triumphs at GCARD 2012. Several of the key changes between draft and revised versions are detailed below.

- the draft Road Map emphasized, 1) stakeholder commitment and partnerships and, 2) 'scaled-up' capacities for research and delivery; the revised version reinforces that while these two elements are necessary, *that most importantly, if AR4D is to achieve its goals, the outputs of the partnerships and revitalized research must be available to (and shaped by) small farmers.*
- the revised Road Map underlines the focus on developing-country needs as the starting point for AR4D - research pathways, milestones, and targets *must be defined by individual countries, within the context of their own national development plans.* The original draft centered on the priority-setting activities conducted by the regions pre-conference; the revised version broadens the scope and responsibility by saying that *a well-functioning AR4D system has 'national and regional development objectives as the driver and national systems and regional organizations as the foci, supported by international and regional actions as required.'*

- the revised Road Map acknowledges *synergies between regional research priorities and the CGIAR Research Programs (CRPs), and concludes that they provide a useful starting point for a global cooperative effort*; it proposes that the CGIAR SRF, the CRPs, and GCARD 2012 processes should be aligned and focused on establishing specific goals and developing the required sub-regional/regional/national inputs and capacities to deliver desired impacts around the proposed thematic areas.
- at the same time, while emphasizing the importance and need for collective action, as was mentioned in the draft version, the revised Road Map reiterates *the responsibility of national research and innovation systems for increasing their capacity and ‘filling the backlog of underinvestment’*. The revised version calls attention to the effect of *stalled-political commitment* in an effective AR4D system, which has resulted in gross under-investment in both national and regional research organizations.
- the revised version elaborates on the draft’s assertion that *effective and comprehensive monitoring and reporting systems are needed to record developments and provide feedback on implementation*.
- lastly, the revised version lays out explicit actions and responsibilities for all stakeholders and actors, including specific financial estimates for increased investments.

The DRAFT Road Map

To transform the agricultural research for development system into a cohesive whole, urgent action is now needed on a variety of fronts.

Who Should Make the Commitment?

This roadmap sets out what is required in the form of collective action among stakeholders over the coming years. Its success will depend on individuals and institutions each to playing their part in delivering shared development goals.

The stakeholders who should commit are:

- National policy makers of developed and developing countries;
- All relevant stakeholders at the local, sub-national, national, regional and international levels engaged in and/or supporting agricultural research knowledge and information systems including the CGIAR, educational, research and extension institutions, and farmers organizations;
- Donors and other development assistance agencies, including bilateral and multilateral institutions and development banks;
- Private sector, including small, medium and large agricultural input companies, food companies, agricultural banks, insurers and the agribusiness sector;
- Civil society organizations at all levels, from sub-national to national and international;
- Representatives of the poor and women;
- Stewards of the environment.

Towards a Well-Functioning AR4D System

The resulting reforms, assuming that they have a broad ownership of the stakeholders in the countries and regions where action is most needed, could have major positive impacts on the NARS’ future capacities, incentives, and performance. The transformation should start with the implementation of priorities each region has set out for itself assuming they are broadly shared by stakeholders. Based on lessons learnt through implementation of some high priority programs regional organizations should improve and refine their processes over time. GFAR/GCARD and its

constituent members also should agree on some minimum standards for partnerships in strategic areas of collaboration based on some of the principles outlined in chapter 5, defining the *combined* objectives of developing countries, the CGIAR and other partners, their relative comparative advantages, and the principles of subsidiarity, i.e. letting actors at the relevant levels take active responsibility for implementation of programs designed in pursuit of sustainable intensification by the poor, their expected outputs and impacts.

The current timeline for the final approval of the SRF and thematic areas (or mega-programs) and the inputs of the regions in that process clearly needs to be revisited after GCARD 2010.

GCARD 2010 is the first step in a series of GCARDs in support of the Road Map for a long-term (4 to 6 years) process. It needs to establish clear milestones to achieve alignment in global AR4D.

A well-functioning AR4D system could have the following ten characteristics:

1. Starting with priorities already established through regional consultations and sought to be implemented by Regional Organizations, taking early steps to help facilitate their implementation;
2. Helping to ensure focus on researchable technologies and/or their delivery to meet farmer constraints on technology adoption;
3. Helping to address constraints identified by Regional Organizations, e.g., human resource development, incentives for scientists, accountability and effectiveness of multiple partnerships.
4. Facilitating the rapid generation of innovations in support of the spread of knowledge and technologies to small holders and identification of improvements needed in the delivery of services to involve and reach the poor;
5. Promotes effective use of collective capacities by strengthening key relationships among research, development (extension, seed suppliers, the banking sector) and farmer actors;
6. Actively achieves increased investments in human, institutional and financial resources;
7. Promotes coordinated operational linkages among development actors aimed at monitorable development impacts;
8. Increasing mutual and equal accountability among all stakeholders;
9. Committing to action;
10. Achieving credible monitoring and evaluation and reporting on what has changed.

Role of the Global Forum on Agricultural Research (GFAR) and GCARDs

The Global Forum on Agricultural Research was established to be an open and inclusive platform for all those involved in agricultural research and its role in development. As recognized by the G8, GFAR is well-suited to serve as a platform and apex body. But both GFAR and its regional constituent bodies need to be strengthened, acquiring increased legitimacy through inclusiveness and endorsement by its constituents, financial resources, expertise and credibility based on its and their demonstrated track records. GFAR's governance includes members from developing and developed country institutions (NARS, private sector, civil society, CGIAR, farmers' organizations, bilateral and multi-lateral donors, and international organizations) and has the broad upstream and downstream reach to include institutions that play key operational roles.

With strengthening, together, they can play key roles in i) advocating for agricultural research (and hence agriculture) in development, ii) helping to improve capacity of NARS and SROs to catalyze actions among the necessary stakeholders to collectively transform agricultural research systems for greater development impact, and (iii) providing leadership at the global level.

GCARD 2010 provides a unique opportunity to set in motion the process of transforming agricultural research for development (TAR4D). A series of biennial GCARDS over the next several years can become the vehicles for initiating and promoting cycles of learning and change. GCARDS can take on a combination of advocacy, mobilization of finance for investments, and human and institutional capital development at the national, regional and international levels.

A global transformation of research for development cannot be achieved without the commitment to investments and necessary institutional changes. GFAR will need to work through its constituencies and other partners in the international community to strengthen the many existing partnerships by:

- Starting to implement regional priorities identified through regional consultations;
- Helping them to improve their accountability to their constituencies;
- Building the capacity of the NARS and regional organizations to implement their priorities, improve incentives;
- Mobilizing appropriate support for strengthening the national, sub-regional and regional research organizations to help carry out the pro poor, pro women and pro environment agenda;
- developing briefs (documents) for policy makers to highlight the current state of AR4D and the potential contributions of AR4D;
- Working with its constituent regional bodies to reflect the particular regional needs and establish a process to fully introduce AR4D into the agendas of the different political and economic regional bodies (e.g. G8, G20);
- Working with multi-lateral, regional and bilateral organizations and development banks to establish a common strategy for the improvement of the effectiveness of the global AR4D system.
- Lobbying, monitoring and reporting on increased investment commitments by both developing and developed countries including the added capacity for innovation generated in developing countries from the baseline year of 2010.

For this to take place GFAR structure should be strengthened with the appropriate technical capacities. Its constituent regional fora should also undergo an in-depth review so as to assure they can play their strategic and leadership role in terms of taking the global discussion to the regional level and effectively connecting NARS, policy-makers and local stakeholders to the GFAR process as well as the CGIAR reform process and future MPs.

New Ideas and Best Practices

New ideas and best practices are needed. GFAR constituencies should collectively undertake the development of best practices related to the improvement of the architecture of the global system and its component by focusing on the improvement of:

- a) AR4D implementation processes by assuring transparent accountability to stakeholders, including particularly the poor, results-based management, achieving full gender participation, and monitoring and evaluating of implementation efforts;
- b) the global AR4D architecture by effective partnership strategies, mechanisms to increase the spillover effects of multi-country investments and capacities, better harnessing the outcomes of the reformed CGIAR research system towards development impact, and more public-private partnerships (PPPs), and deployment of new products for the benefit of the small-scale and resource-poor;
- c) the content of AR4D by making better use of foresight methodologies, strategic planning that fosters the creation of new knowledge as well as the capacity to seek existing technologies, research priority-setting to focus on reducing the vulnerability of poor people, and ensuring a

diversity of approaches that include combinations of traditional knowledge, conventional technologies, agro-ecological methods and modern biotechnology;

Exogenous Factors

The largely exogenous conditions for delivery include the need for secure land rights, revival of extension systems, engagement of CSOs, development of policy capacity, promotion of rural infrastructure and information technology, and establishment of appropriate financial institutions.

Monitoring and Reporting System for an Evolving TAR4D Global System

An effective transformation needs a process with clear reporting and accountability. This should be built on objective data on key indicators that enables (i) keeping track of changes and their results, and (ii) a transparent feedback to all concerned stakeholders about progress on the transformation strategy and its implementation.

GCARD should thus establish a monitoring and reporting system to track commitments and progress towards a more effective global AR4D system. This system should:

- Develop a baseline analysis of the state of the AR4D system, starting with 2010 as the base year and including all partners currently not included in the research and reporting;
- Track improvement in the capacities, incentives and management systems in which national and regional organizations seek reforms;
- Ensure countries are committed to developing the databases for their countries as tools for policy-making.
- Develop a transparent registry of actions, commitments and responsibilities by national and international actors;
- Support a permanent mechanism enabled under GFAR for the development of key indicators on investments and capacities in research, human resource development and institutional innovations in support of food security, poverty reduction and increased environmental sustainability;
- Ensure the wide dissemination of results to those concerned with AR4D at least every two years at successive GCARDS and to policy makers in the G8 and G20.

The Responsibilities of Individual Developing Countries

Developing countries including emerging economies should commit to:

- a) Taking leadership positions at their respective levels;
- b) Enhancing their own policies, institutions and investments in support of achieving better impacts on the poor;
- c) Fostering institutional innovations to transform their national and regional AR4D systems;
- d) Incorporating their strategic needs to support such transformation in strategies;
- e) Adopting an inclusive process involving all relevant stakeholders to develop strategies on what technologies and knowledge need to be generated or mobilized nationally and how to access new technologies and knowledge from external sources;
- f) Strengthening their SROs and ROs as instruments to foster regional cooperation, better use of available resources, and improved scientific infrastructures.

Industrialized Countries, Emerging Economies and Global and Regional Organizations

Industrialized countries, emerging economies and international organizations should commit to:

- a) Adopting explicit commitments to increase investment and human resource development to (i) meet MDGs or nationally-established goals for poverty reduction, food security and environmental sustainability, and ii) ensure that national and international efforts attain the required levels of investment;
- b) Supporting national efforts to build SROs and ROs to complement national efforts, particularly to support smaller countries, so as to achieve the necessary scale to effectively meet research needs and promote international standards and accountability in research management;
- c) Ensuring effective inclusion of research, extension and capacity development in rural development programs funded by governments and donors.

Concluding Comments

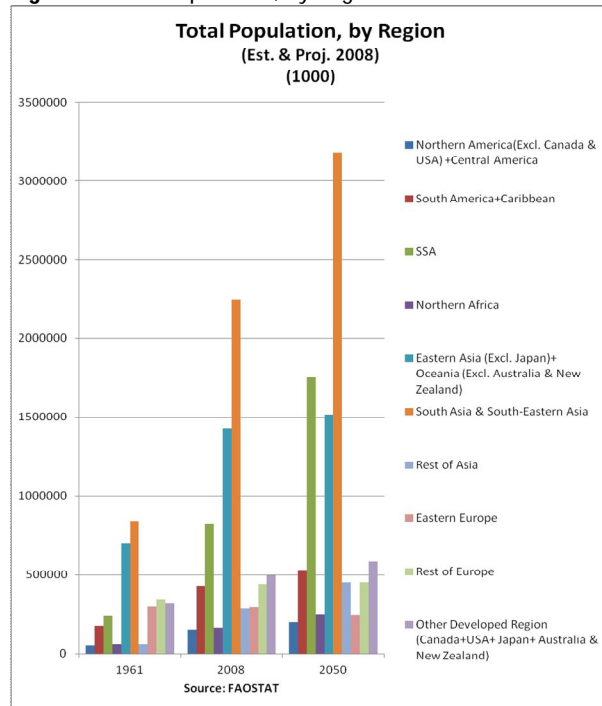
Agricultural research and development efforts that engage farmers and build from the bottom-up can release locked-up innovation, become responsive and effective, encourage many different pathways, and result in adequate food for all. Without investments in agricultural and overall economic and social development, research alone would be a blunt instrument in efforts to eradicate poverty and hunger.

Chapter 1: By 2050 A Warmer Crowded Interconnected World of 9 Billion People

The World in 2050

This first Global Conference on Agricultural Research for Development (GCARD 2010) provides a unique opportunity for reflection and *action*. The aim is to begin transforming the current fragmented global system of cooperation in science, technology, and related policies and institutions to meet the growing challenges of food insecurity, poverty, changing consumption patterns and environmental degradation. On the demand side the world is likely to contain some 9 billion people by about 2050. Urban populations will increase from today's 3.4 billion to well over 6 billion. Almost all this growth will occur in developing countries. Sub-Saharan Africa's population will continue to grow while Asia's tapers off by 2030. With higher incomes and different tastes, diets in developing countries will shift from low to high value cereals, poultry, meats, fruits and vegetables. This will constitute an improvement for many; at the same time, this nutrition transition is likely to see the adoption of obesogenic diets by many social groups. The changing consumption patterns will create more employment in peri-urban agriculture and through value chains since urban women with more work and less time will embrace modern appliances and demand foods which are more processed, packaged and easier to cook. But it will also have implications for energy use as a result of growing transportation and processing of raw food as well as for food quality and food safety, mimicking some of the challenges of industrial agriculture in advanced countries.

Figure 1. Total Population, by Region



(Lele and Agarwal, Forthcoming)

Potential for Variable Performance Among Regions of the World

The FAO estimates that by the middle of the 21st century more than 90% of the world population may live in countries with an availability of more than 2700 kcal per capita per day, up from 51% at

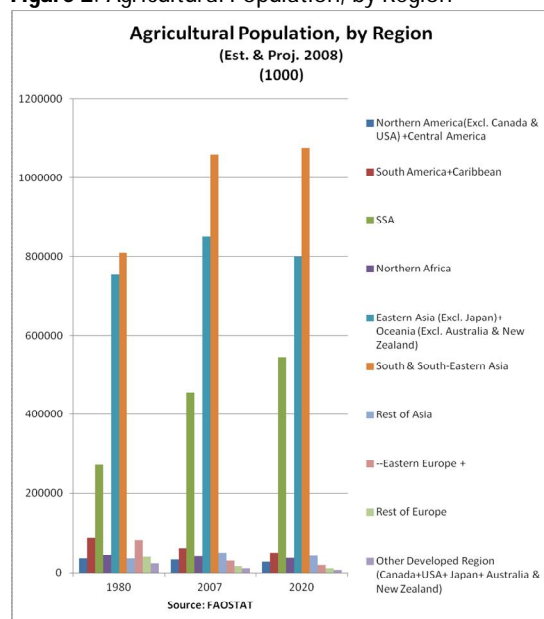
present and only 4% three decades ago (Wik et al., 2008). Agricultural and overall economic growth rates have and will continue to have an important role in these scenarios. Economic growth rates have already reached close to double-digit numbers in China and India, and other countries are following suit. Indeed as a group, post 2000, developing countries, including Sub-Saharan Africa, performed better than OECD countries until the food and financial crises struck (Agarwal, 2008). Improvements in the most populous countries will carry a significant proportion of these improvements.

Least Developed Countries

But not all countries and individuals in them will perform as well. 32 countries had average undernourishment rate of 42% (see Chapter 2 for further discussion of this issue). The population of these poor countries is projected to increase from the current 580 million people to 1.39 billion by 2050, and food consumption will under “fairly optimistic assumptions” increase from the current 2000 kcal/person/day to 2450 kcal in the next 30 years, still not enough for good nutrition in several of these countries. Reducing undernourishment may be a very slow process in many countries (Wik et al., 2008).

Heterogeneity in the Role of Smallholder Agriculture in Employment, Income Generation and Structural Transformation from Agriculture across Regions

Figure 2. Agricultural Population, by Region

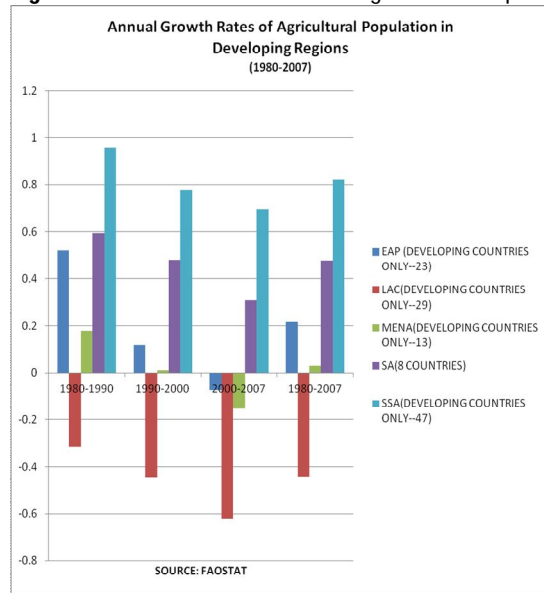


(Lele and Agarwal, Forthcoming)

The role poor women, men and children residing in the rural areas will play in this radical structural transformation will depend on the distribution of land holdings, extent of the land access and security, and employment opportunities. The regions are very heterogeneous both within and across the developing world and well as in their stages of development. Some have already experienced substantial decline in the share of population in agriculture, e.g. Latin America and the Caribbean and the Eastern European region, but in other regions the share of population in agriculture has not yet begun to decline and there is considerable population pressure on the land (see Figure 2, Figure 3, and Figure 4). Thus for example, in South Asia average cultivated land per person has been declining rapidly and is as low as 0.3 ha per person. It is slightly over 0.7 hectare in South-east Asia, about 2.5

hectares in Sub-Saharan Africa, the Middle East and North Africa but well over 8 hectares per person in Latin America and Eastern Europe.

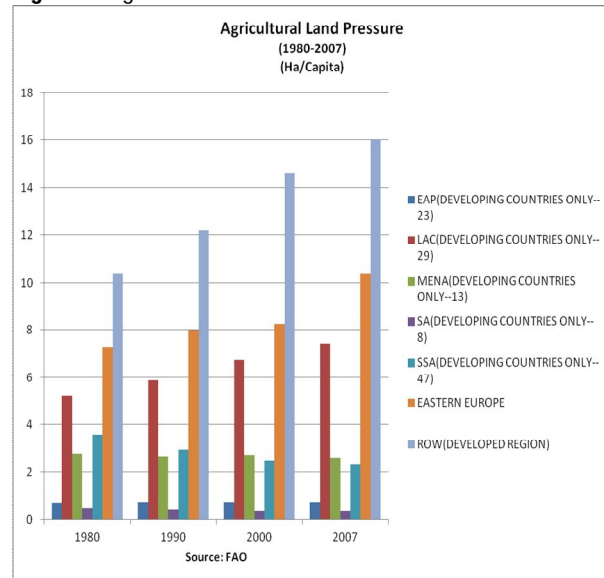
Figure 3. Annual Growth Rates of Agricultural Population in Developing Regions



(Lele and Agarwal, Forthcoming)

With larger share of urbanized population average land size has been increasing in Latin America and Eastern Europe. Needless to say smallholder agriculture is the dominant mode of production in Asia and Sub-Saharan Africa and agricultural growth is far more labor intensive than in Latin America or Eastern Europe, where capital intensity of agriculture is already high and productivity on larger scale farms has been increasing, with declining share of labor in agriculture. In sub-Saharan Africa, by contrast, analysts project growth to be heavily labor intensive with only moderate increase in capital base, with limited efficiency gains. Some projections for the gross value of production for instance suggest that revenues generated by an agricultural laborer in sub-Saharan Africa will rise only by 50 percent over the next four decades. The expected growth in food markets will not suffice to lift revenues significantly but this would depend a great deal on how much capital is invested in agriculture and of what kind, issues explored later in this report (Schmidhuber et al., 2009).

Figure 4. Agricultural Land Pressure



(Lele and Agarwal, Forthcoming)

Smallholder agricultural growth has provided strong linkages to the growth in the non-agricultural sector through backward and forward linkages. Besides growth linkages of small scale agriculture to the rest of the economy have been much larger than of large scale agriculture (Timmer, 2004; Hazell and Haddad, 2001; Lele and Mellor, 1981; Johnston and Mellor, 1961). Thus agricultural and non agricultural linkages have been shown to be much stronger, creating more employment and incomes in both the agricultural and the non-agricultural sectors in much of East South East and South Asia relative to Latin America where farm sizes are larger. Smallholder agriculture in Africa has been shown to be efficient (Lele, 1975, 1991; Pretty et al., 2006), and more so than large scale agriculture even though large farms achieve higher yields because large farm use *more of all inputs* to relative to small farms (Lele and Agarwal, 1989).

Consolidation of land holdings and increased farm size is a natural outcome of successful economic modernization as labor moves out of agriculture and is substituted by capital, increasing labor productivity. However labor can also “move out” of agriculture due to a failure to provide secure land rights to small farmers resulting in land grab and disincentive to investment in agriculture, an issue discussed in chapter 4. By the same token a failure to achieve sustained productivity growth in smallholder agriculture has historically led to a temptation to embrace a large farm strategy, including for example, most recently in Sub-Saharan Africa (Collier and Dercon, 2009; Wiggins, 2009). Although large farms have a place where there is a history of large scale farming and land has been plentiful, there is no question that smallholder agriculture will have to be the mainstay of agriculture in both Asia and Africa, as the sheer number of small farms and the large size and share of population in agriculture in these countries requires and given that a large share of the agriculturally dependent population has smaller and smaller plots of land to cultivate.

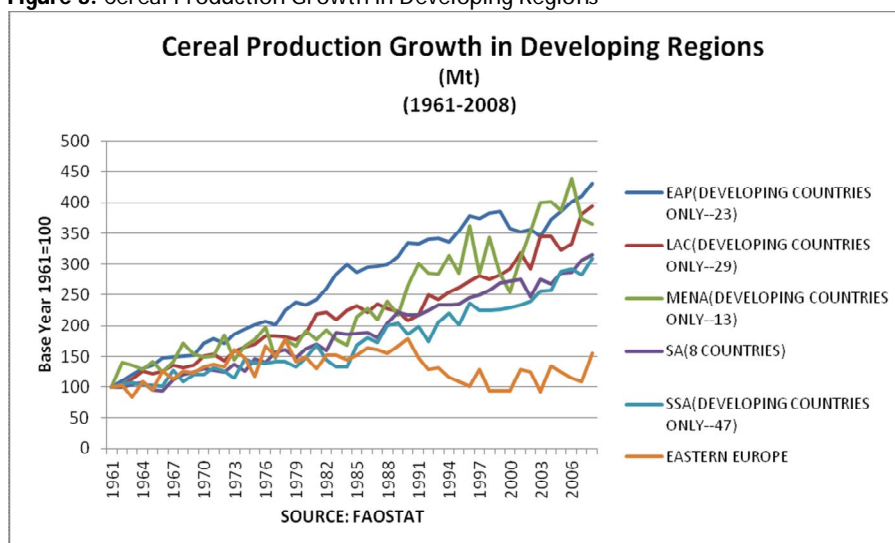
Past and current factor endowments i.e. land available relative to population densities, the sizes of countries and markets, the stages of their development, policies and institutions all vary substantially and the tremendous heterogeneity in turn continues to influence policy decisions. Depending on the pathways of policies and investment strategies countries will choose to pursue, their economic performance will either converge over time or diverge substantially from each other.

Future scenarios thus vary considerably depending on the assumptions the models, such as those presented at the FAO Expert Meeting on Feeding the World in 2050 make about the extent and

patterns of economic growth, investment requirements, climate change and energy use, sources and efficiency.³ Indeed, FAO has refined its own projections of food demand and supply on a routine basis to attune them to the realized population, income, production and market changes (Alexandratos, 2009). Growth in demand for the range of different biofuels is expected to change any one of the recently made projections substantially including across regions.⁴ Yet even taking into account greater future share of international trade in food consumption, the FAO estimates that developing countries will need to double their cereal production (mainly of rice, wheat and maize) to meet the expected growth in food demand. The same applies to poultry, fish and livestock production, the demand for all of which has been growing even more rapidly but the projections for which are far less developed. Yet it is clear that having exhausted much of the fish population in the wild, to meet the growing demand for fish, aquaculture, like poultry and dairy would grow in importance with implications for the scale of enterprise development, choice of technologies, employment creation and environmental impacts. All these future demand projections have implicit in them priorities for agricultural research in terms of commodity production that would need to increase or natural resources which would need to be managed sustainably.

A key question remains on the demand for and the role of root crops, tubers and many so-called “inferior” rain fed crops such as sorghum and millet. Root and tuber crops are quite important in production and human consumption in many parts of the world, particularly in Africa (see Figure 5 and Figure 6). Pulses and beans rich in protein are important in production and consumption in South Asia and have been declining in production, which has adversely affected the supply of proteins, in turn also affecting soil health in the rice wheat systems that replaced traditional farming systems in the Ganges delta. Production of beans and pulses is, particularly important for countries largely dependent on vegetarian diets even in the face of income changes and urbanization and often the poor households are the producers of these crops that have seen little technological change. Research on rice wheat systems has shown substantially high rates of returns, and benefits to the farming populations.

Figure 5. Cereal Production Growth in Developing Regions

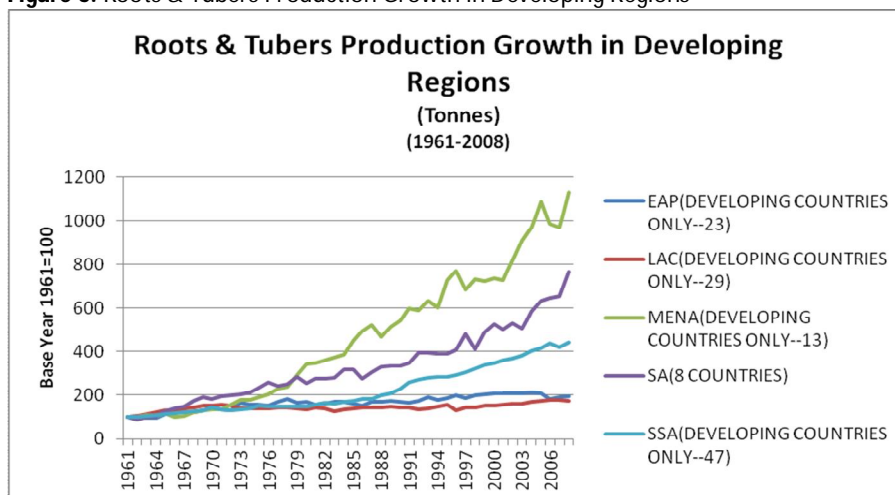


(Lele and Agarwal, Forthcoming)

³For further information please reference the reports and proceedings of the FAO Expert Meeting on How to Feed the World in 2050, 24-26 June 2009, FAO Headquarters, Rome.

⁴ Ibid.

Figure 6. Roots & Tubers Production Growth in Developing Regions

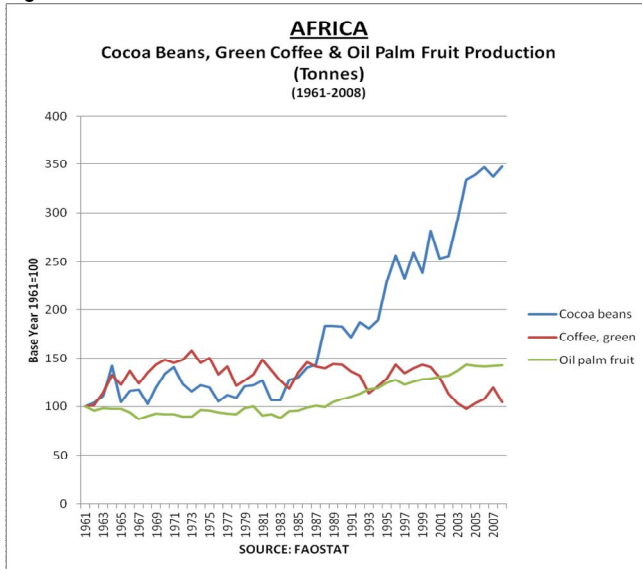


(Lele and Agarwal, Forthcoming)

Some of the “orphan crops” too contain substantial nutritive value and meet caloric needs of the poor, particularly the indigenous forest dependent people of which India alone has close to 60 million. Most these crops have seen little research or productivity growth and are rapidly losing their genetic diversity. The CGIAR lacks their gene banks. The McKnight Foundation and the M.S. Swaminathan Research Foundation (MSSRF) have been supporting research in these areas, believing that wild genes would be of substantial value for breeding in the context of increasing climate variability (Lele and Gandhi, 2009; Lele and Coffman, 1995). MSSRF has also been working with indigenous households that have been the guardians of these orphan crops to promote in and ex-situ conservation to ensure sustainable livelihoods. Their future role in human consumption, even of the poor, beyond the intensification of livestock production and industrial uses however remains unclear due to global neglect of these issues but needs more attention in future research.

Perennial crops, although often seen as competing with local food crop needs, can also be crucial elements of export income and economic growth, e.g. coffee is the second most valuable globally-traded commodity after oil, while cocoa brings more finance directly into Ghana’s rural areas than does the country’s largest export, gold (see Figure 7).

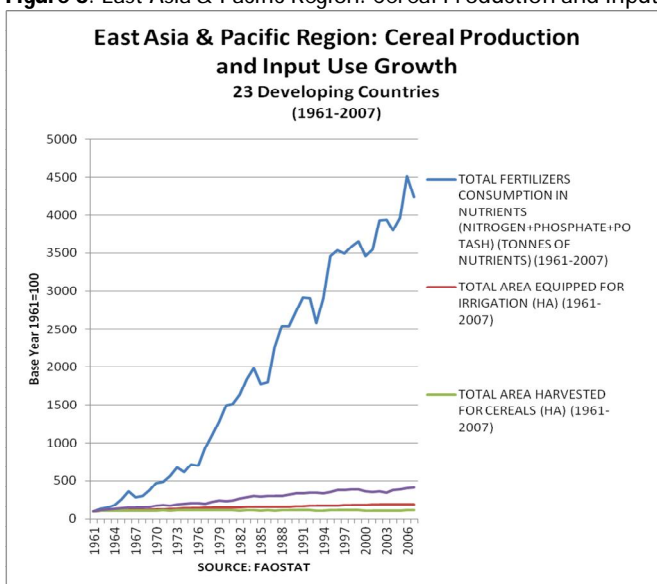
Figure 7. Africa: Cocoa Bean, Green Coffee & Oil Palm Fruit Production



(Lele and Agarwal, Forthcoming)

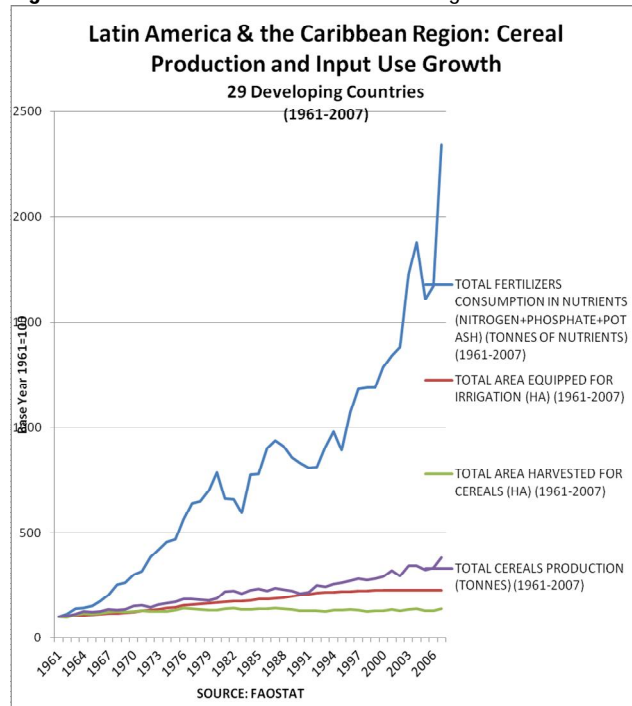
The demand on natural resources of growing irrigated crops such as rice and wheat compared to rain fed crops may also enter consideration in research and production priorities as water shortages increase (Rosegrant et al., 2010). Whereas productivity of the three major cereals (rice, wheat and maize) has increased more rapidly than of the rain fed crops consumed by the poor, productivity growth has slowed in recent years due in part to the neglect of financing of plant breeding research on these important crops in future demand (see Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, Figure 13 and Chapters 2 and 3). Smallholder dairying has similarly shown advances in many countries (Spielman and Pandya-Lorch, 2009; von Braun et al., 2008). Production of poultry, fish and livestock too has grown and yet knowledge about productivity changes in the *smallholder* sector is patchy although these activities constitute an important source of current and future livelihoods for the poor with growing peri-urban and urban markets. In this vein, as countries grow they tend to substitute capital for labor with increase in total factor productivity as labor moves out of agriculture.

Figure 8. East Asia & Pacific Region: Cereal Production and Input Use Growth



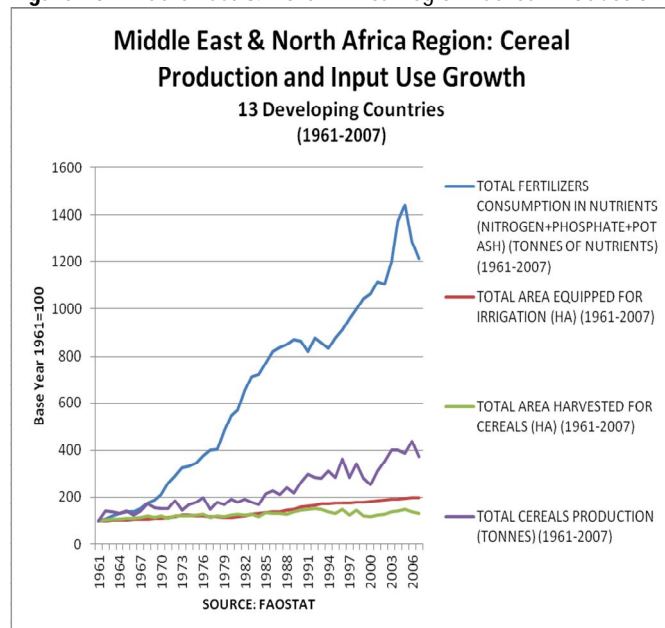
(Lele and Agarwal, Forthcoming)

Figure 9. Latin America & the Caribbean Region: Cereal Production and Input Use Growth



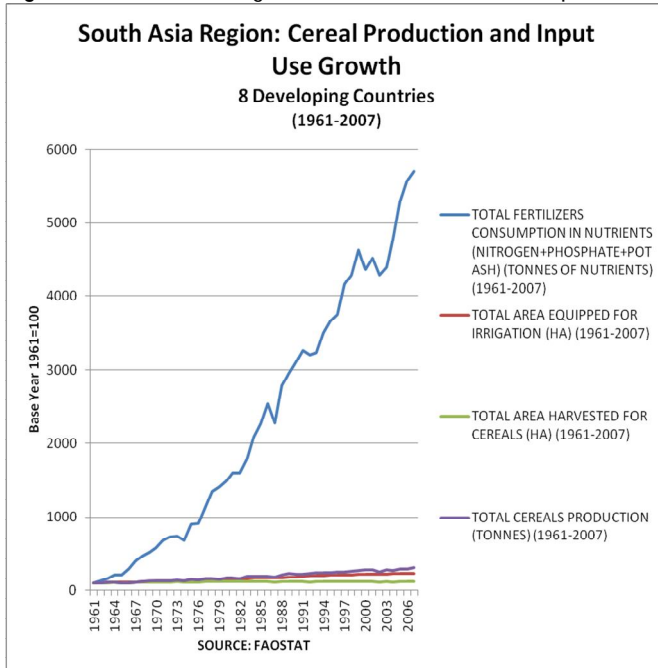
(Lele and Agarwal, Forthcoming)

Figure 10. Middle East & North Africa Region: Cereal Production and Input Use Growth



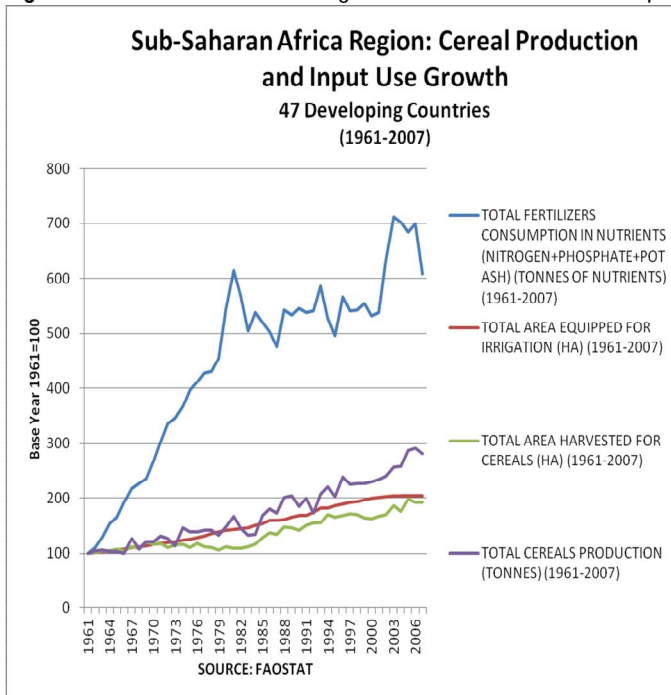
(Lele and Agarwal, Forthcoming)

Figure 11. South Asia Region: Cereal Production and Input Use Growth



(Lele and Agarwal, Forthcoming)

Figure 12. Sub-Saharan Africa Region: Cereal Production and Input Use Growth



(Lele and Agarwal, Forthcoming)

Figure 13. Eastern Europe Region: Cereal Production and Input Use Growth (NOT AVAILABLE)

(NOTE: Due to a change in coverage of countries and incomplete reporting, FAO data for Eastern Europe do not allow time series analysis as in the case of other regions.)

Global Integration of Markets

The food and energy price increases of 2007 combined with the financial crisis of 2008 brought to a halt the optimism about rapid progress in food supply through technological change, productivity growth and declining real commodity prices. These crises led to considerable new analysis and insights.

Experts agree that the food price boom of 2007 was part of a larger boom fueled by many interacting factors that characterize today's global markets. It was not just declining growth in investments in agricultural research and technology over the past two decades, which is a principle theme of this paper, but also low past investments in extractive industries such as oil and natural gas, the weak dollar, fiscal expansion in many countries, and, to some extent, investment fund activity in the financial markets (van der Mensbrugghe et al., 2009). Diversion of some agricultural commodities to the production of biofuels, adverse weather conditions, global stock declines to historical lows and government policies, including export bans and prohibitive taxes, accelerated the food and other price increases and eventually led to the 2008 hike (van der Mensbrugghe et al., 2009).

A strong consensus has also emerged that increased link between energy and non-energy commodity prices, strong demand by developing countries (when the current economic downturn reverses course) and changing weather patterns prompted by climate change together with related natural resource challenges will dominate the shape of commodity markets for the coming decades (van der Mensbrugghe et al., 2009). Precisely what shape those markets will take is difficult to predict.

Interconnectedness has had beneficial impacts as well as downsides

With the rise in food prices, it is almost certain now that the first Millennium Development Goal established in 2000 of halving the proportion of the world's hungry by half by 2015 from its 1990 base level will not be met. The cascading effects of the food and financial crises on food, poverty and insecurity have been global and deeper than before. With reduced size of international trade and investments, falling employment, returning migrants from abroad and from urban centers, and with reduced remittances, agriculture and rural sectors have become the safety havens for the poor, much like in the Asian crisis of 1998. The financial crisis has swelled the ranks of these to well over 2 billion people, a third of the global population who now earn less than \$2.50 a day. With an increasing number of the poor dependent on the market for food, price increases hurt those living in or returning to the rural areas the most. Most also lack access to formal social safety nets. Global food stocks are low and food aid deliveries are down.

Increased Role of Science and Technology: Mainstreaming Sustainability

Two recent influential British publications (Royal Society, 2009; Conway and Waage, 2010) stress the importance of science, technology and interdisciplinary problem-solving research to address these challenges both in terms of the well-proven record of science in the past and future prospects for its contributions. Both take an inclusive view of science that embraces biological, information and GIS technology, human and animal health research; and an equally broad view of what constitutes science, ranging from local to global, indigenous to genomics, social to biological. This is also a spirit embraced in the work of M.S. Swaminathan, progenitor of India's first Green Revolution. The appeal of the British scientists to the UK and EU governments to invest more in research to bring about a substantial impact on poverty through sustainable agricultural intensification, or the doubly green revolution, has parallels with Swaminathan's appeal for an evergreen revolution. That broad a view of science and its role in public policy by contemporary scientists is better understood by the challenges faced in today's agricultural research with its many dimensions of sustainability. The

challenges are too great and the speed of scientific progress in recent years too rapid to leave any options unexplored.

Evidence proves their point. Returns to agricultural research have been high (Renkow and Byerlee, 2010; Evenson and Gollin, 2003). Although the Green Revolution started in the 1960s, during the 1961-1980 period, a large number of developing countries achieved production growth mainly through smallholder households increasing area under cultivation. In the post-1980s thanks to investment in science and technology (see Chapter 3) and concurrently in agriculture and rural development including in irrigation, fertilizers, seed production, agricultural finance, a vast number of smallholders in developing countries (including in the case of some crops in some countries in Sub-Saharan Africa) adopted these new technologies and experienced agricultural production growth concurrently with growth in agricultural productivity (Wik et al., 2008).

Modern plant varieties contributed more to yield growth in the decades after the 1980 than in the previous 20 years (Evenson and Gollin, 2003). Investment in plant breeding and associated inputs and infrastructure development in developing countries resulted in increased productivity. In ten countries productive inputs were declining in the post-1980s concurrently with growth in agricultural production, due to growth in total factor productivity (Wik et al., 2008). Had there not been agricultural intensification, including particularly in Asia, the world would have needed to bring millions of hectares of additional land under cultivation beyond today's millions of hectares to achieve the same agricultural production (Renkow and Byerlee, 2010; Evenson and Gollin, 2003).

Box 1. Broadening the concepts of agricultural intensification (Lele, 1991; Pretty, 2008; Royal Society, 2009).

Traditionally agricultural intensification has been defined in three different ways:

- Increasing yields per hectare,
- Increasing cropping intensity (i.e. two or more crops) per unit of land or other inputs (water),
- Changes in land use from low-value crops or commodities to those which enjoy higher market prices (from pulses to rice and wheat in the Ganges Delta, from maize to fruits, vegetables and flowers in Kenya).

- Total factor productivity (TFP) growth is the difference between growth in aggregate output and aggregate inputs.

- *Sustainable* agricultural intensification is producing more output from the same area of land *while reducing the negative environmental impacts and at the same time increasing contributions to natural capital and the flow of environmental services.* (Godfray et al., 2010; Royal Society, 2009; Conway and Waage, 2010).

Sustainable agricultural systems cannot be defined in terms of the adoption of any particular technologies or practices. There are no blueprints. If a technology assists in efficient conversion of solar energy without adverse ecological consequences, then it is likely to contribute to the system's sustainability. Sustainable agricultural systems also contribute to the delivery and maintenance of a range of public goods, such as clean water, carbon sequestration, flood protection, groundwater recharge, and landscape amenity value.

Few of these resources, commodities or services have "market" value and therefore the cost benefit of conservation is determined by the scarcity value of resources (e.g. willingness of farmers or populations in urban areas to pay for watershed protection). To achieve scalability of resource management interventions public education as well as public policy and informal or formal regulatory institutions with enforceable capacity are crucial. Although sustainable agricultural systems are, by definition, more resilient and less vulnerable to shocks and stresses, determining the level and timing of incentives needed for conservation and the mechanisms to bridge the divergence between the private and the public benefits, between local and national or global costs and benefits, to adopt sustainable practices tend to be key challenges (van den Berg and Feinstein, 2009) in the type of characteristics typically attributed to a sustainable production system:

- i. Utilizes crop varieties and livestock breeds with a high ratio of productivity to use of externally-derived inputs;

- ii. Avoids the unnecessary use of external inputs;
- iii. Harnesses agro-ecological processes such as nutrient cycling, biological nitrogen fixation, allelopathy, predation and parasitism;
- iv. Minimizes use of technologies or practices that have adverse impacts on the environment and human health;
- v. Makes productive use of human capital in the form of knowledge and capacity to adapt and innovate and social capital to resolve common landscape-scale problems;
- vi. Quantifies and minimizes the impacts of system management on externalities such as greenhouse gas emissions, clean water availability, carbon sequestration, conservation of biodiversity, and dispersal of pests, pathogens and weeds.
- vii. It is clear that development practitioners must increasingly and simultaneously traverse two paths, namely of development and environment.

Looking ahead, FAO estimates the world agricultural production growth will slow to 1.5% annually in the next two and a half decades and then to 0.9% annually in the succeeding 20 years to 2050, compared with 2.1% per year since 1961 (Alexandratos, 2009; Wik et al., 2008). The reasons for this predicted slow down range from the lower population growth and the gradual achievement of medium to high levels of per capita consumption in a number of countries cited earlier (Wik et al., 2008) to slowing rates of yield growth through a variety of causes (Fischer et al., 2009).

Expanding the production frontier to achieve higher potential yield levels through research calls for increased investment in all types of agriculturally-related science and making better use of existing technologies and indigenous innovation. Science focuses on understanding and improving crop and animal genotypes by all methods as well as on agro-ecological management, in addition to improving the capacities of people and their institutions to deliver inputs, manage systems, and distribute and use outputs. In most situations there is a gap exceeding 30 percent between farmer yields and potential yields, but it is as great as 100 percent in several rice cases and can be several times higher in tree crops. The rate of gap closing has been slow suggesting that there is substantial scope to bridge the yield gap by better understanding the constraints smallholder agriculture faces in adopting new practices and increase farm productivity. For maize progress in farmer yield is often 1.5 percent or better, but it has been difficult to get good estimates of progress on potential yield. The gap between farmer yield and potential yield is large in maize, especially in sub-Saharan Africa where it easily exceeds 100 percent (Fischer et al., 2009).

Closing the yield gap between the best yields and those realized by a large majority of farmers calls for increased investments in adaptive research, extension, and a variety of other delivery services which constrain yield growth (as explored in chapters 3 and 4).

Sustainable productivity growth adds an entirely new dimension to investments in science and technology.

Even though it is said that 150 million hectares of land could potentially be brought under cultivation (mostly in Latin America and Africa), a consensus is emerging among promoters of sustainable intensification that all future food production increase *should* come from productivity growth on already cultivated lands. Expanding the agricultural frontier into new lands would result in losses of important natural habitats, biodiversity and environmental services, including the valued use of wild foods by many rural households (Royal Society, 2009; Godfray et al., 2010; Bharucha and Pretty, 2010).

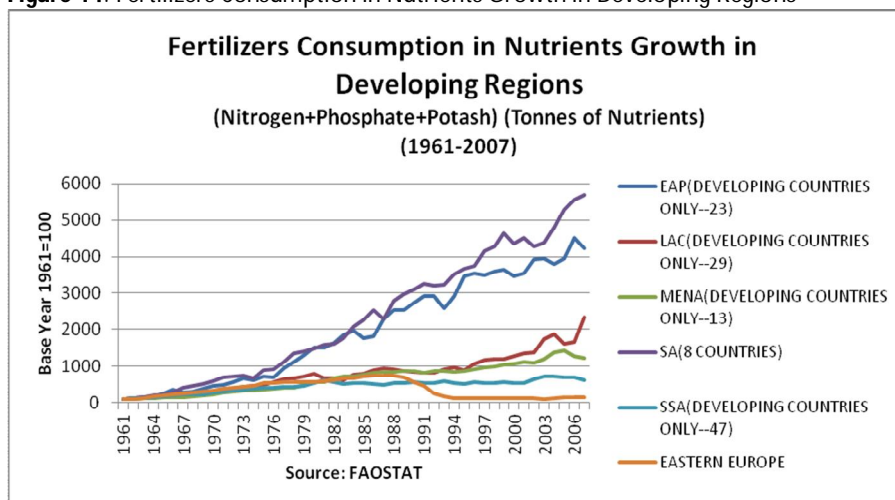
Unlike in the past it should thus come through sustainable agricultural intensification (Box 1). However, this view is not universally shared. Binswanger (2009) argues that there are wide tracks of

Cerado-type lands in sub-Saharan Africa which can be brought under cultivation. Collier and Dercon (2009) argue that the challenges of substantial increase in food production and climate change cannot be squared with a continuing commitment to smallholder agriculture as the main route for growth in African agriculture and for poverty reduction. They question the evidence base for an exclusive focus on smallholders, and argue for a much more open-minded approach to different modes of production including large scale farming to move low productive labor out of agriculture while at the same time achieving food security in sub-Saharan Africa.

However, this view ignores the fact that many countries with rural poor do not have alternative urban or rural income streams that can be turned on as a substitute for mass employment in agriculture, also that there is now a blurred continuum between rural and urban and smallholder farming and other income sources as seen in Bangladesh and parts of India.

Sustainable productivity growth of small farmers on existing lands has very different implications for how much public investment to make in science and technology, and into which kind of science and technology as it occurs at different levels from the local to national, regional and global. It also has very different implications for different regions of the developing world given that the process of agricultural intensification is at a different stage in Latin America and Asia relative to Sub-Saharan Africa with very different levels of modern input use and the degree of intensification (Renkow and Byerlee, 2010) (see Figure 14).

Figure 14. Fertilizers Consumption in Nutrients Growth in Developing Regions



(Lele and Agarwal, Forthcoming)

Lessons from Evidence of Research Impacts for Future Allocation of Agricultural Research Resources at Various Levels and Types of Research

Renkow and Byerlee (2010) draw important implications for allocation of research resources at the local, national and international levels using a subsidiary principle depending on the types and levels of impacts different types of agricultural research has had, e.g., on germplasm research, policy research and natural resource management research. They note for example that "... research contributions in crop genetic improvement, pest management, natural resources management, and policy research have, in the aggregate, yielded strongly positive impacts, and appear likely to continue doing so.

But in their view *crop genetic improvement research stands out as having had the most profound documented positive impacts* and whereas substantial evidence exists that other research areas within the CGIAR too have had large beneficial impacts. These impacts have often been local and national rather than international. The “right-time, right-place” nature of successful policy research and the relatively limited geographic scale of much natural resource management research appear to limit the overall scale of impacts of these programmatic thrusts vis-à-vis genetic improvement research. They conclude that “the CGIAR’s portfolio of research allocations has become overly skewed toward natural resource management and policy research over time; hence, restoring somewhat the share of resources allocated to crop genetic improvement in the CGIAR is warranted” (Renkow and Byerlee, 2010). The flip side of their finding is that majority of such policy and natural resource management research should be undertaken at the country and local levels, working directly with farm households and consumers. These findings have profound implications for the organization of research discussed in chapters 3, 4 and 5.

Research on Deforestation, Climate Change and Environmental Services

Opening up new land for cultivation would also entail the high costs of new infrastructure development. Besides if land use changes are brought about by conversion of forest lands into agriculture, they would further contribute to GHG emissions and climate change in much the same way that bringing more land under cultivation in the recent past has done. This will mean further adverse impacts on climate, rainfall patterns, water availability and biodiversity. Increases in pest and diseases, soil erosion and loss of watersheds will also continue unabated.

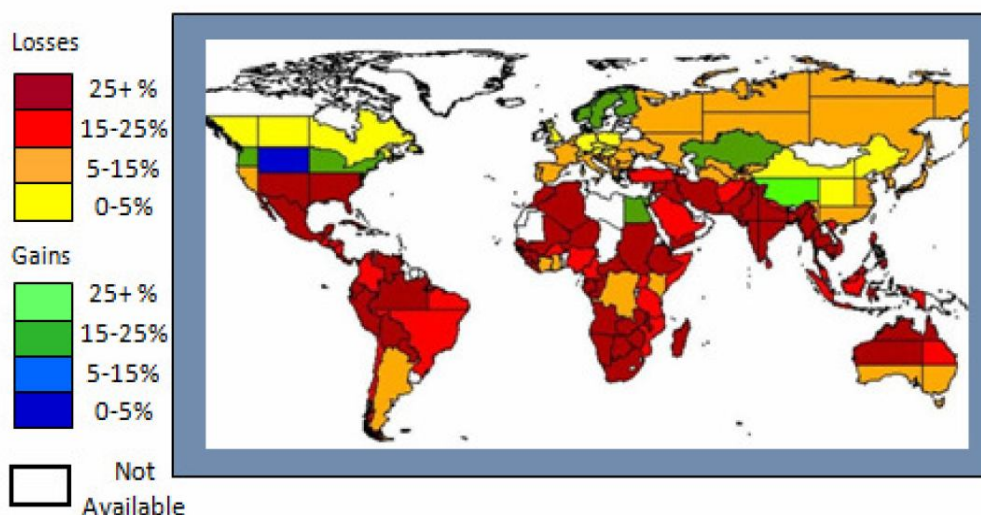
The Stern Report estimated that nearly a third of all GHG emissions, almost equal to those from automobiles, already come from the combination of agriculture, livestock and deforestation. Research on environmental sustainability of agricultural intensification will need to be undertaken both at the micro level of farms and communities but also at scalable macro levels of countries and regions of the world (Stern, 2006). Countries with the world’s largest tropical forests rich in biodiversity and carbon, namely Brazil and Indonesia, have been the largest GHG emitters of forest carbon through land-use changes. Fast growth in China and the concomitant import demand for soybeans, livestock, and palm oil, combined with commodity price rises of 2007 provided a great impetus for conversion of forest margins to agriculture particularly in Brazil. On the other hand, having exhausted their forest margin, most Asian countries, China and India included, have gained forest cover, China by a spectacular 40 million hectares.⁵ Costa Rica has been at the forefront of a program on payments for environmental services. Many of these issues are at the center stage of the climate change agreement in the stalled debate in Copenhagen. Research needs to contribute to the design, implementation and measurement of outcomes of such large schemes including particularly in understanding their total costs and benefits as perceived by different stakeholders. Serageldin notes that the Stern “report focuses on climate change and does not take into account the food, feed fuel combinations” (2009: 14).

Research on production systems that use fewer synthetic inputs, less water and more sustainable crop mixes without giving up productivity growth will be particularly critical in a wide range of irrigated areas where a variety of water issues, water logging, salinity and timing and quantity of water available have been huge issues for some time (Pretty et al., 2006). This kind of research also poses a challenge of integration of research on crops with that of water management. In many countries agricultural research institutions tend to be crop-focused whereas those concerned with water belong to other Ministries.

⁵China proposes to bring more land under forests through the world’s largest Grain for Green Program under implementation since 2000. The program entails \$50 billion committed to convert marginal crop land into forests by 2015.

The challenges in semi-arid areas of Sub-Saharan Africa and Asia, or in **the coastal areas**, all likely to be affected most severely by climate change, are quite different where much of the increase in production has come from area expansion with low use of modern inputs and very complex locally divergent cropping systems and constraints with regard to soils, moisture, pests and diseases. The diversity of constraints and the lack of scalability in this kind of research pose particular challenges for science and technology to deliver products and knowledge for scalable intensification that is environmentally sustainable.

Figure 15. Potential impact on agricultural production due to climate change (without carbon fertilization effect)



(Cline, 2007, in van der Mensbrugge et al., 2009)

Research on Mitigation and Adaptation and Implications for Future Research

Mitigation has received more attention (for example through programs such as REDD and the Bio Carbon Fund) than research on adaptation even though risks and uncertainties are particularly severe for the poorest, 95% of who are concentrated in South Asia and sub-Saharan Africa and are already badly affected by climate change with more adverse impacts predicted with considerable uncertainty as to their nature, timing.

The World Bank's modeling of a longer term outlook, for example, projects significantly higher temperatures (the rise of 2.5° C) than most of those that form the basis of the climate change analysis presented in the IPCC Fourth Assessment Report (van der Mensbrugge et al., 2009; IPCC, 2007). The damage to agricultural productivity could be as high as 40%, particularly, mostly expected to occur in South Asia and Africa.

The Case for International vs. National and Local Public Goods Research

There is considerable debate about the specific roles of "international public goods" research in the areas of climate change adaptation and resilience, particularly in place of enabling national systems to increase their capacity substantially and urgently to address these complex issues which will likely remain for years to come. Not only do the growing conditions tend to be very diverse but even the concepts of adaptation and resilience varies depending on the nature of the precise resource management challenges. Interdisciplinary research is not only weak in Europe and North America, due to incentives for disciplinary scientists to work in silos, the benefits of research or interventions

are often not easy to define or to measure. This leads to a vigorous debate among professionals of different disciplines about whether what is not measurable does not count.

What is clear is that “participatory, interdisciplinary” *approaches to research on community management of natural resources* that combine advanced science with local adaptation will need to be carried out at the local and national rather than at the supra national levels and that vigorous methodologies will be needed to determine if the findings of research are to be replicable. Besides such research will likely be highly skill-intensive and may have fewer scale economies. Scale economies will be possible mostly in the case of germplasm improvement. The latter has shown consistently very high rates of return but allocations to germplasm research have suffered severely in the CGIAR in relation to policy research or research on natural resource management (Kelley and Gregerson, 2004; Renkow and Byerlee, 2010; World Bank OED, 2003a).

Research on NRM or policies lacks replicability or scalability, thus such research in these areas would need largely to be conducted at the national level, with at the minimum active participation of national researchers and local communities on an equal footing to co-create knowledge, learn and replicate, if poverty reduction on a large scale is the objective. Partnerships among unequal partners in terms of skill mix, financial and human resources and incentives hold few chances of success. (Chapter 5) Moreover research carried out without deep roots in the countries whose problems are being analyzed is less likely to have long-term sustainable impacts on policies and institutions. This has implications for how partnerships for NRM research are designed, funded, implemented and evaluated as well as for investments in science and technology capacity in developing countries (see Chapter 5).

Appropriateness of the current Results Based Framework for Impact Analysis

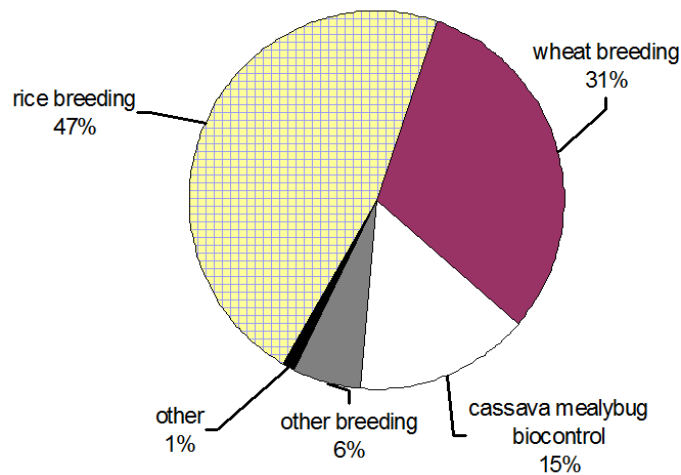
The current evaluation frameworks focus on inputs, outputs, outcomes and impacts. They have been developed for accountability in the uses of funds and is unlikely to be adequate to deal with issues of risk and uncertainty, adaptation and adaptability of different groups, and the iterative nature of decision-making based on learning in response to changing circumstances. In this regard the CGIAR faces a dilemma. Its recent reform measures are even stronger on seeking evidence on the system’s effectiveness although whether the effectiveness is to be measured at the level of research outputs or on ultimate impacts on poverty is unclear. Many of the results are likely to be difficult to quantify including particularly the benefits for the poor (Picciotto, 2009).

Implications and Limitations of Existing Impact Studies as a Guide to Research Resource Allocations in the Framework of Poverty Reduction

Raitzer and Kelley (2008a) inventory the literature for all ex post impact assessment of outputs derived in part from CGIAR centers between 1971 and 2001, review the quality of individual estimates, and set aggregate reported benefits against total CGIAR investment to date. This analysis finds that under a range of stringencies in inclusion of individual studies based on their rigor, benefit cost ratios are high (ranging from 2 to 17).

At the same time, most of the benefits derive from a very small subset of CGIAR research (Figure 16). Benefit estimates reported in individual ex post impact assessment studies reveal are concentrated in three areas: 1) rice genetic improvement; 2) spring bread wheat genetic improvement, and 3) cassava-mealybug, which collectively account for 94% of documented benefits under the “plausible” scenario. Of these, only rice and wheat genetic improvement are sustained long term CGIAR research activities, as cassava mealybug biocontrol was an intensive project of limited duration.

Figure 16. Percentage of benefits derived from different research areas in the Raitzer and Kelley (2008a) scenario of "plausible" studies.



A substantial portion of the benefits assessed is likely to have accrued through reduced food prices as a result of supply curve shifts attributable to staple productivity enhancement, such as is evidenced by Sanint and Wood's (1998) findings that 70% of rice genetic improvement benefits in Latin America accrue to consumers. This is a considerably pro-poor effect, as poorer groups spend greater proportions of their income on food (Kerr and Kolavalli, 1999) which is further reinforced by the low expenditure elasticities of these staple commodities.

Natural resource management and policy oriented research are noticeably absent in their contributions to the overall benefits assessed (World Bank OED, 2003a). Despite dedicated subsequent efforts to try to identify the benefits of these research areas (Waibel and Zilbermann, 2007; Science Council of the CGIAR, 2006c); no cases with comparable levels of benefit values have been identified. This suggests that rice and wheat genetic improvement are unique as core sources of international agricultural research impact for the poor.

Research on pesticide use has also shown substantial health benefits of such research of the users of pesticides (IRRI, 2008). Assessing impacts of policy research poses a number of methodological challenges but also stresses the location specificity of policy research and the need to build national capacity for it and also stresses the location specificity of most such research (IRRI, 2008).

Chapter 2: The Current Patchy State of Micro-Economic Knowledge on Levels and Determinants of Poverty to Assess Impacts of Agricultural Research

Food Security, Poverty and Gender

Hunger threatens development in many ways: resulting in caloric and nutrient deficiency, increased susceptibility to disease and, by reducing access to adequate and nutritious foods, also the effectiveness of health interventions to contain HIV/AIDS and tuberculosis. Hunger encourages child labor, leads to withdrawals from schooling particularly of girls, prompts outmigration, and, at worst, permanent destitution, prostitution, child trafficking. It also fuels conflicts. World Bank President Zoellick noted that in 2007 rising food prices caused urban food riots in over 30 countries, threatening political stability (FAO, 2009a, 2008; Zoellick, 2008). The price rises of 2007 and their impacts particularly on the poorest households even living in rural areas brought to the center stage the importance of food security at the *national level* as an essential element of development strategies of countries in much the same way they had in the 1970s, and in ways they still continue to in the large successful emerging economies (Timmer, 1997).

Over time the focus on food security has correctly evolved from the national to the household level with mounting evidence since 2007 that food price rises increase the vulnerability of the poorest households the most (FAO, 2009a; von Braun, 2008). At the household level, evidence is preponderant that rural women are disproportionately represented among the poorest *agricultural* households and lack access to a wide range of assets including land, extension, agricultural inputs, water, etc. (Peterman, et al., Forthcoming; Quisumbing and Pandolfelli, 2010). Several studies also find average productivity is lower for female headed households and on female plots than for male counterparts (Peterman et al., 2009; Quisumbing, 1996; Udry, 1996). Their numerical importance is due to a combination of factors: male migration, disease related male deaths, increased feminization of agriculture from changing patterns of agricultural production, e.g. from traditional export crops in which male workers have been the principal labor force to non-traditional fruit, vegetable and flower production involving increased employment of women. The increased employment of women in the more formal rural and semi-urban labor markets related to agricultural value chains is explained by their view as docile and less organized workers, lacking in union power. *And yet there tends to be great "misrepresentation and under reporting of women's contribution to agriculture and even though there has been progress, in sensitizing statistics bureau.* A study for 18 Latin American undertaken by IICA at the beginning of the 1990's showed between 50% and 300% more women than those reported by official census and household surveys (Chiriboga et al., 2006; Lastarria-Cornhiel, 2006).

And of course there is great variation across countries. Women's participation in agriculture is greater in poorer countries and among poorer households. Participation decreases with increases incomes and then increases again as households become more affluent. Women's education is known to have impacts on children's health and nutrition. Hence the importance of investing in women in a variety of ways including in improving their agricultural practices, education and health (Lele, 1986).

Meinzen-Dick et al. (2010) recent review of literature carried out for GCARD also shows however that despite these changing trends, which remain largely invisible, women's traditional roles in fetching fuel wood and water, cooking and minding children have not changed much particularly among the poorest households, nor their access to such little public extension services which exist, nor to secure property rights or to agricultural finance and markets. Community Driven Development programs often do not involve them directly because the CDDs largely focus on the provision of infrastructure, i.e. feeder roads, water points and school buildings (World Bank and IFPRI, 2010). The latter benefit

all rural populations including women, but there is also evidence that women's participation changes the preference set for interventions whether related to research or agricultural services. The fact that the change in inclusion of women is slow is not surprising given that gender roles are largely culture driven and culture changes at its own pace, and differently in different places and different respects. But this provides all the stronger reasons why there is need for interventions to increase women's access to services.

There are many examples of progress in women's inclusion, through policies and practices in developing countries where the poor are most concentrated, e.g. in Asia and Africa. Thus the 30 percent representation of women mandated in local panchayats in India and most recently in the parliament, a variety of civil society driven development programs through Amul are examples of this phenomenon as are BRAC and Grameen, SEWA and the Swaminathan Foundation directed specifically to women (see Box 6, Chapter 3), through the formation of women's groups for vegetable farming and marketing in East Africa, via the inclusion of women in land registration in Ethiopia (Deininger et al., 2007) and in land legislation in Uganda (Deininger et al., 2008), through the growing practice of women obtaining gifts of land from men in return for their work in cocoa farming in Ghana (Lele, 1986; Quisumbing et al., 2001).

Regional consultations stressed repeatedly that today's agricultural research is insufficiently poverty-oriented (Chapter 3), but contributions to the GCARD articulated less well how the gender dimension of poverty, or the extent of progress against this development objective and implications for the future AR4D should be taken into account. This is not surprising. There continues to be very limited systematic harboring of knowledge *at the micro (household and individual) level* on the nature of poor households on which global level advocacy, policy and strategy are based, whether at the international or the national levels. This paucity of knowledge has serious implications for the way MDGs are being monitored or the interventions to achieve them are designed, i.e., in segmented, insular ways, explaining the disconnect between health and food security interventions (Conway and Waage, 2010; Desai, 2007).

The constraints to the poor are so interacting -- between health, lack of their own labor due to already long hours of work, quality of water, lack of access to energy for cooking, etc. -- that improving access to an entire gamut of constraints is essential. More micro -level indicators are needed to assess how we are improving the quality of life of poor households by redressing insecurities of food, fuel, water, access to nutritious foods, services, security of tenure, and finance. In this regard, several studies discussed in Chapter 1 note that the impact studies focus on a relatively narrow range, e.g. of technical change on productivity growth but not on whether and how the poor have benefited (Raitzer and Kelley, 2008a). The more recent studies have begun to look at the cross sectoral impacts (e.g. of pesticide use in rice on health) (IRRI, 2008).

Measures of Poverty and Food Insecurity from the Perspectives of Roles and Impacts of Agricultural Research 4 Development

The most widely used poverty and food insecurity estimates for global monitoring are undertaken by the World Bank and FAO respectively. They reflect well the zigzag of focus on food security and poverty reduction in the CGIAR's mission's statements over the years and are relevant in assessing impacts of research.

There is a widespread consensus that sustained broad based/ inclusive economic growth achieves food security for most households most of the time through increased incomes such as that has occurred in most of East and South East Asia (Timmer, 1997). As necessary countries produce or import food, although increased caloric intake may be accompanied by obesity, lack of food safety,

or micro –nutritional deficiency. Furthermore some bottom income level households may lack the necessary purchasing power either all the time or may fall into poverty in the case of crises (e.g. the Asian Financial Crisis, Tsunami, droughts or global food price increases). The decisions on how to address those crises rest with individual nations.

Poverty reduction through inclusive economic growth is achieved both through agricultural and industrial growth as in South or South East Asia through large or small scale agricultural development or through large scale agriculture and substantial transfers, e.g. social security, cash transfers or indeed even land transfers, as in Brazil and South Africa. FAO SOFA (2009b) describes various safety net programs including in particular Brazil's Bolsa Familia - which provides conditional cash transfers for school attendance, vaccines and prenatal care, extended from 10.6 million to 11.9 million people in 2008 following GDP decline of 3.6%, and Ethiopia's (which seems to face constant crisis) largest Productive Safety Net Program in Africa of cash or food which goes to 7 million Ethiopians and depends a great deal on WFP's food aid.

Food Security too can be addressed through public food distribution programs at subsidized prices, or through non-farm employment schemes as in much of South Asia (e.g. India's national rural employment scheme, and Integrated Child Development Programs) or through cash transfers, food aid or WFP funded food for works programs as in Sub-Saharan Africa. All these latter activities are important for food security; however, they are not the areas in which *agricultural research* has a comparative advantage. AR4D's comparative advantage lies in issues related to equitable and sustainable increase in agricultural production, value addition, market access, and safe distribution of food and agricultural production (see Box 2). Within this broad concept of agriculture broadly defined to include food as well as non-food crops, the main specific comparative advantage of the CGIAR lies in the areas of globally traded cereals and root crops and as a convenient funding and operational mechanism for international action. Its activities in forestry, agro-forestry and water address some of the issues related to the sustainability of some of the natural resources but are also increasingly important as a vehicle for related actions such as addressing climate change. Its policy work helps address some of the food security issues at the global, regional and national levels. Much like in the case of agricultural research generally, the CGIAR's comparative advantage lies in productivity enhancing research and not in food aid, cash or food transfers, or food for works programs.

Box 2. What Does A Transformed Agricultural Research for Development Mean?

A Transformed Agricultural research for development is one that helps to achieve sustainable food and income security for all agricultural producers and consumers and particularly for the resource poor households, whether they are in rural or urban areas. *Sustainable* agricultural intensification means producing more food and agricultural products from the same overall resources (e.g. land, labor and water) *while reducing the negative environmental impacts and at the same time increasing contributions to natural capital and the flow of environmental services*. Sustainable agricultural systems cannot be defined by silver bullets, i.e. acceptability of any particular technology or practice. There are no standard blueprints.

AR4D is research that:

- Operates on the principles of subsidiarity: activities are best conducted at the level at which there are the responsibilities and accountabilities, and where research results need to be applied;
- Builds its priorities from the bottom-up through socially-inclusive processes involving the poor and the disenfranchised;
- Brings into play a diversity of approaches, technologies and practices, including combinations of traditional knowledge, conventional technologies, agro-ecological methods and modern biotechnology;
- Exploits and integrates participatory approaches with scientific and experimental methods;

- Ensures results-based management effectively integrated with innovative science and development;
- Even at the local level routinely devises methods to assess progress of implementation of processes through systematic independent monitoring and evaluation;
- Maintains its identity and operation separate from development actors though seeks effective partnership strategies and linkages to all other relevant agricultural and rural development investments and policies at all levels;
- AR4D is *not* development but contributes to it through greater sensitivity, active partnerships, vigorous commitment to building the capacity of partners including particularly the beneficiaries and increased accountability for more and better results on all fronts: poverty reduction, productivity growth and environmental sustainability. It makes trade-offs explicit and helps decision-makers choose better options.

Science for Sustainable Intensification

Science focuses on understanding and improving crop and animal genotypes by all methods as well as on agro-ecological management, in addition to improving the capacities of people and their institutions to deliver inputs, manage systems, and distribute and use outputs. There is a need to creatively link farmer's own innovation systems with those from science to build mutual understanding and trust and so better benefit from both. Participatory and interdisciplinary approaches to research on community management of natural resources, that combine advanced science with local adaptation, are needed but will require vigorous quantitative and qualitative methodologies for outcomes to be *replicable at scale*. They will be highly skill-intensive.

At the same time, we need to harness the best of advanced innovation in a range of scientific and social science disciplines, from telecommunications to micro-insurance, molecular biology to meteorology as all can provide valuable tools for agriculture, food and rural development.

Sustainable intensification emphasizes not only technology -related research but also other types of research aimed at triggering policy and institutional changes. It also needs the development of enabling institutional environments for the local and global communities to build on strengths, address weaknesses, exploit opportunities and remove threats to achieving sustainable development.

Therefore TAR4D means producing more and better research aimed at delivering credible facts, ideas, concepts and a menu of options for the benefit of the poor including current and alternative future scenarios, drawing on history, culture and contemporary developments in a wide range of areas, in a form which can help identify values, perceptions, needs, constraints and bottlenecks which all stakeholders either possess, face or can benefit from.

Outputs can help design, monitor and evaluate interventions undertaken by multiplicity of actors in many sectors *at all levels*. It can help to develop appropriate mechanisms, partnerships and innovation pathways that can translate research products into development impacts *at scale*, from the local to global, to improve development outcomes and impacts globally.

From this perspective it is useful to review the measures of poverty and food insecurity available for global or regional monitoring which the CGIAR's strategic research framework has used to assess its mega programs. Each has food prices and food availability at the centre of their estimates.

How useful would they be in assessing future impacts of agricultural research on poverty? The causal chain from research to agricultural prices through adoption of technologies is relatively easy to establish but to poverty reduction is long indeed and tracing the link is fraught with difficulties (including of mega programs of the CGIAR).

Besides there are huge differences in poverty and food security estimates the World Bank and FAO use, using different concepts, data and different approaches to assessing poverty and food insecurity

(Box 3). They are likely to be less useful than more micro level assessments of the current constraints households face and how new technologies and interventions improve their livelihoods.

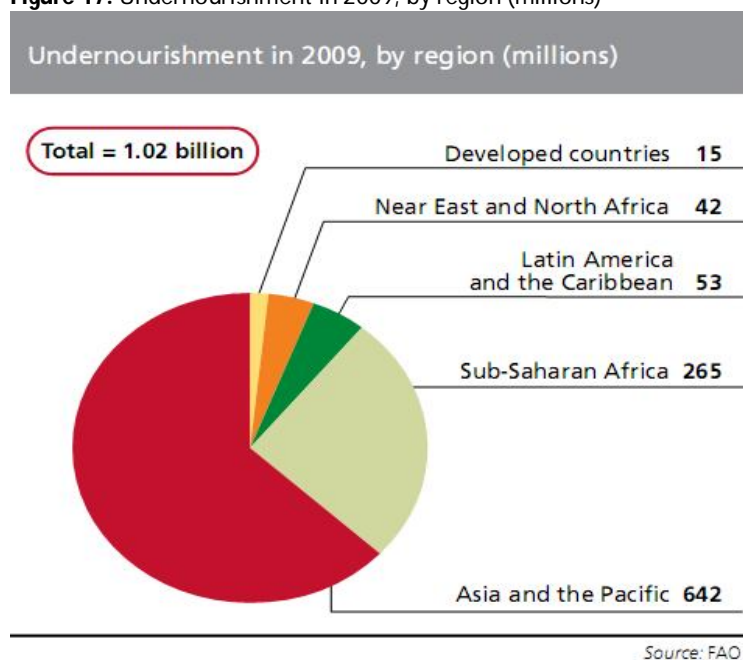
The Bank's revised poverty estimates for 2005, the latest year for which data are available stand at 1.4 billion people living on \$1.25 or less, up from less than 1 billion for the same past period due to revisions in methods of estimation (see Figure 20, next section). According to these estimates an overwhelming 95% of the poverty in the developing world lies in Asia (67%) and in Sub-Saharan Africa (28%). This has increased the number of the poor by 400 million.

While the Bank has not published estimates of the number of poor following the food and financial crisis, it has acknowledged that nearly 100 million additional people might have fallen into poverty, meaning about 1.5 billion; most would be expected to be in Asia and Africa (Chen and Ravallion, 2008).

FAO's Food Security Measures

FAO measures food security using aggregate macro measures of national food production, trade and stocks. Like the World Bank, FAO too has stated that the financial and economic crises have "pushed an additional 100 million people in hunger in 2009. But according to FAO this brings "the overall number of undernourished people in the world to over 1 billion" in 2009 (World Summit on Food Security, 2009). FAO estimated undernourishment in 2009 to be at 1.02 billion *globally, including in developed countries* (Figure 17). Of the nearly one billion 97 percent (642 million and 265 million) respectively were in the Asia and the Pacific and in the Sub-Saharan Africa Regions, including presumably the additional 100 million people pushed into hunger in 2009.

Figure 17. Undernourishment in 2009, by region (millions)



This suggests that the World Bank's measures of poverty, if they were calculated for 2009, and FAO's aggregate measures of food security, may differ by nearly 500 million. Clearly these macro measures are not the best measures to assess impacts on either poverty or food security as the CGIAR's SRF does (Chapter 5). Both depend on a variety of factors which are difficult to measure.

Instead the level and determinants of real food prices and food access of poor individuals and households and other measures such as impacts of chemical inputs or contaminated water on their health are more likely to be robust and easier measures/ indicators of impacts of agricultural research than impacts on poverty levels.

Box 3. Changing Estimates of Global Poverty and Food Insecurity

The World Bank's widely used poverty estimates are based on minimum income required to acquire food for a daily minimum caloric intake needed for an active healthy life. The World Bank's revised estimates are based on a more complete global survey of prices and include surveys in China as well as a revised poverty lines to \$1.25 and \$2.50 a day from the original \$1 a day and \$2 a day. For inter-country comparisons it estimates per capita income in terms of Purchasing Power Parity (Chen and Ravallion, 2008).

The FAO defines Food Security as when all people have, at all times, physical, social and economic access to sufficient, safe and nutritious food that meets their dietary energy requirements and food preferences for an active and healthy life. Whereas the Bank estimates come from the consumption side of the equation, FAO estimates food insecurity from the supply side by calculating availability as the sum of production imports-exports- losses and converting national availability to per capita availability by dividing it by population.

The Bank's revised estimates of global poverty, for 1981-2005, have increased the estimate of poverty level for 2005 period by about 400 million compared to its previous estimates (Chen and Ravallion, 2008). This is, primarily because the price levels for most non-OECD countries were revised substantially upward and income, production and consumption levels revised sharply downward, most importantly for China and India. The estimates of GDP per capita in Purchasing Power Parity (PPP) terms are two thirds of those in the World Development Indicators for the same years for China and India (see Chen and Ravallion, 2008, and Hillebrand, 2009, for a detailed discussion). Indian analysts have raised questions about whether the fall in the Indian poverty really has been so small compared to other lower estimates (Bhalla, 2002), but within India too there are disparities in the aggregate and household level estimates, e.g. in the share of consumption in GDP.

FAO too has revised its estimates of food insecure populations for the previous period retroactively with the result that the number of food insecure in the SOFA 2008 are considerably larger for the past years than those estimated before (Alexandratos, 2009)⁶. But despite this adjustment in both there is a large difference in estimates of poverty and food insecurity.

Poverty's Changing Size and Locations over Time Based on the World Bank's Revised Estimates

Using World Bank numbers, there have been dramatic changes both in the levels and location of poverty since 1981.⁷ China's estimated share of poverty in 1981 in the total poverty level of 1.9 billion was 44%; India's share in 1981 was half as much, 22%; Sub-Saharan Africa's share in poverty of 1.9 billion was 11%, slightly less than the rest of East and Southeast Asia (Figure 18). People living in poverty in the developing world as a whole declined very little from 1981 to 1991, to 1.81 billion and

⁶ Alexandratos (2009) notes that the U.N. Millennium Development Goals (MDGs) -- halving the proportion of people who suffer from hunger may be achieved. He argues further, that "despite the slow pace of progress in reducing the prevalence of undernourishment, the projections do imply *considerable overall improvement*. In the developing countries the numbers well-fed (i.e. not classified as undernourished according to the criteria used here) could increase from 3.9 billion in 1999/01 (83 percent of their population) to 5.2 billion in 2015 (90% of the population), to 6.2 billion (93%) in 2030 and to 7.2 billion (96%) by 2050. That would be no mean achievement. Fewer countries ... will have high incidence of undernourishment, none of them in the most populous class undernourishment will tend to become smaller in absolute numbers and in relative terms (proportion of the population), hence it will become more tractable through policy interventions, both national and international."

⁷Of the 1.9 billion poor living on less than a \$1.25 a day in 1981, an overwhelming 85 percent were in Asia. Well over half (56 percent) was in EAP, slightly over a quarter in South Asia and only 11 percent in Sub-Saharan Africa. Only 4 percent of the poverty was in the rest of the developing world in 1981—i.e., in MENA and LAC regions together (World Bank, 2010).

shares changed relatively little, China's share came down to 38 % from 44% and South Asia and Sub-Saharan Africa increasing their shares. The biggest decline in share came about during the 1990 to 2005 period. China's share in a much smaller level of poverty of 1.4 billion was only 15%. India's increased to 33%, the rest of South Asia's to 11% and Sub-Saharan Africa's to 28% (Figure 19 and Figure 20). According to World Bank estimates then India alone now contains nearly 453 million poor, compared to China 206 million. The remaining South Asia and East Asia contained 10% and 9% of the poverty each in 2005. Sub-Saharan Africa's share of 28% of the global poverty showed a steady rise from 11% and 16% in 1981 and 1990, to nearly 385 million.

Some Indian analysts have disputed the World Bank estimates of poverty at these higher levels (Bhalla, 2002) but some others appear to accept that 330 million may be living in poverty and be food insecure (Singh, 2010). Even though smaller in absolute numbers, India's greater share of the developing world's poverty is explained by the fact that Indian economic reforms started nearly 15 years after the Chinese reforms and China and South East Asia's economies, including their agriculture and manufacturing sectors, grew far more rapidly for a longer period than India's creating more employment and incomes including for their poor (India's overall all growth performance indicators have picked up since 1991 and track perfectly with those of China if superimposed on its earlier period (Agarwal, 2008). Nevertheless China has invested far more resources in the rural sector than India. Its agricultural productivity growth has been higher and social indicators have improved at a substantially more rapid rate than India's. How much poverty will be reduced in India and South Asia more generally will depend on the extent to which many of the policy, investment, institutional and resource issues are addressed, e.g., of land, water and soils, explaining the slower agricultural productivity growth well articulated by Chand (2009).

The LAC and MENA regions have shown much more mixed performance of their economies from year to year although agriculture of the largest country in LAC, Brazil has performed very well.

Figure 18. 1981: Population living below \$1.25 a day

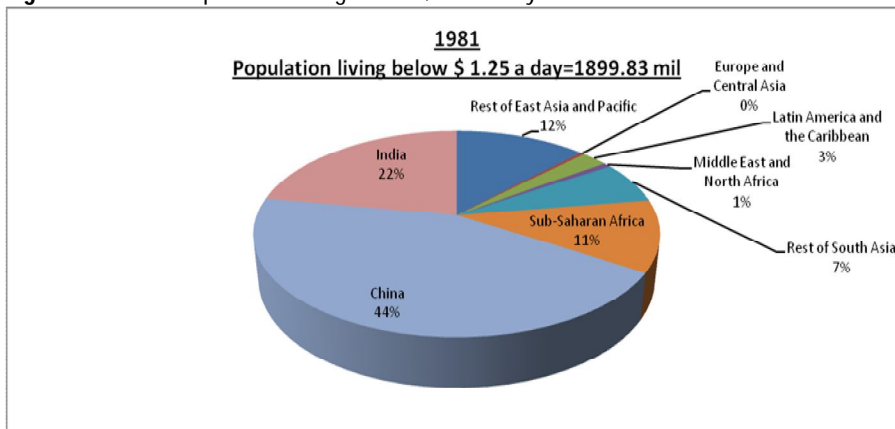


Figure 19. 1990: Population living below \$1.25 a day

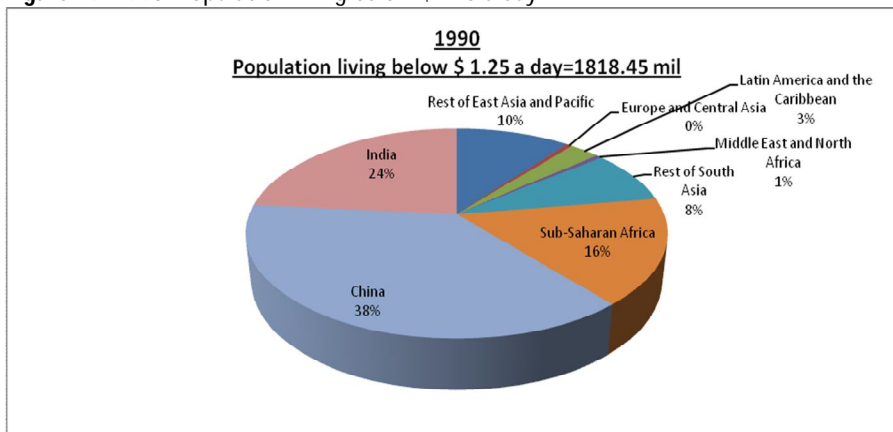
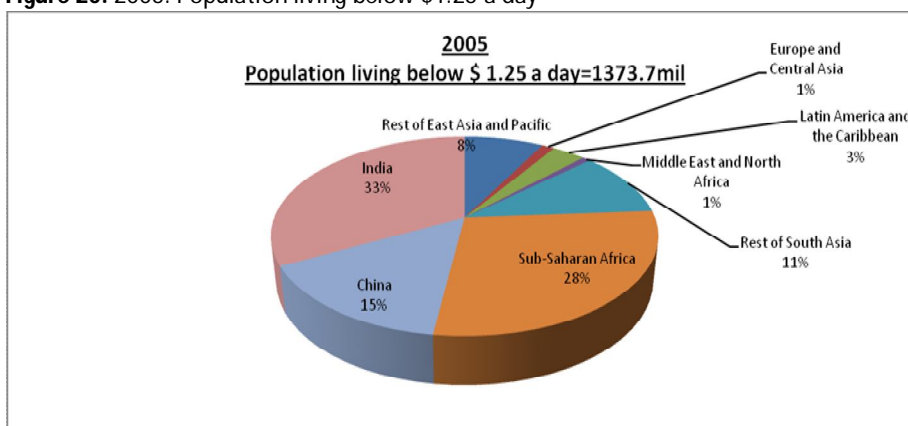


Figure 20. 2005: Population living below \$1.25 a day



(Data Source: World Bank, 2010; Lele and Agarwal, Forthcoming)

IFPRI's Global Hunger Index

IFPRI captures yet other dimensions of hunger: insufficient availability of food (i.e. proportion of people who are food energy deficient according to FAO), shortfalls in fewer than 5 years of age, the nutritional status of children (prevalence of underweight in children) and child mortality. It reports that worldwide progress in reducing hunger remains slow; South-east Asia, the near-East and North Africa and Latin America and the Caribbean, the latter two regions with already very low incidence of global hunger—have reduced it substantially since 1990 and in Sub-Saharan Africa progress has been marginal. South Asia and Sub-Saharan Africa stand out as still the regions with the highest ranking global hunger indices—despite the big drop in South Asia from the 1988-92 bases of 7 % points. South Asia continues to have the highest proportion of fewer than five children who are underweight although the incidence of child mortality has declined. Sub-Saharan Africa's overall GHI at 22.1% is still slightly lower than in South Asia at 23%.

The countries that have made the most progress in these areas are mostly middle income countries—Brazil, Saudi Arabia, Mexico, Malaysia. A number of African countries have lost in GHI, including DR Congo, Burundi, Zimbabwe, Liberia, Gambia, Sierra Leone and Swaziland.

Investment Needs in Agricultural Research and Development

Chapter 3 addresses issues of investments in the agricultural research systems of developing countries. While cross country data on agricultural research are not available for a more recent

period, recent data for provided at the BRICs meeting indicate that Brazil's investments in agricultural research have been increasing as well as its international partnerships in recent years; this following a decline in investments during the late 1990s followed by a stagnation in the early 2000s (Chapters 3 and 5)⁸. China's research system like Brazil's has been tremendously more productive than India's when the agricultural performance of the three countries is considered.

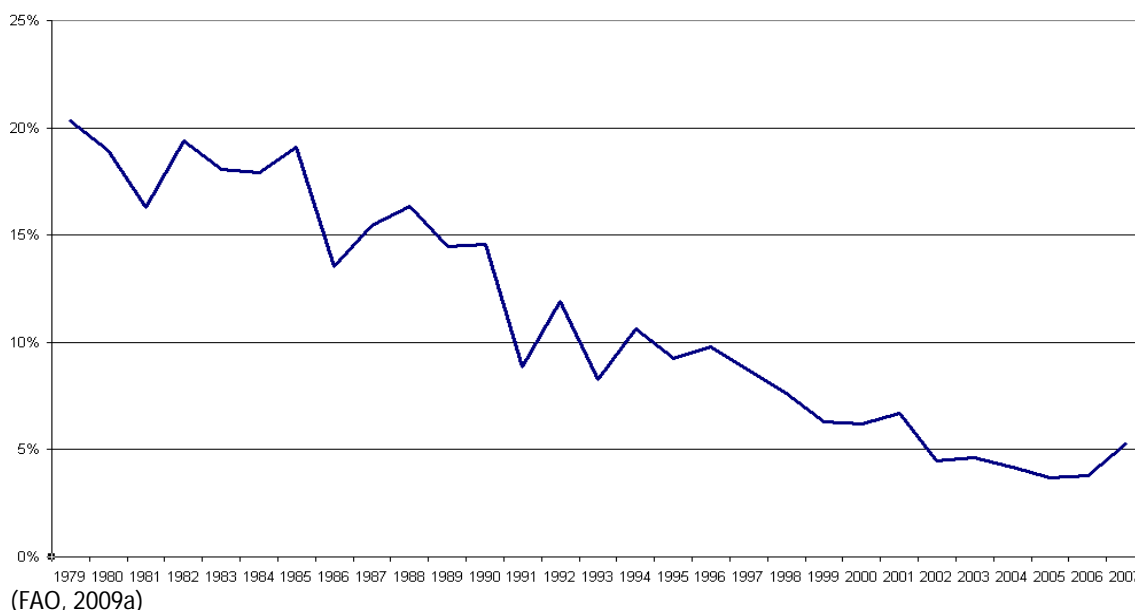
To achieve rapid agricultural and rural growth however requires tremendous complementary investments in irrigation and water management, rural roads, agricultural finance and extension among others. There is considerable evidence that developing countries' own investments in these areas have seen reduced rates of investments, perhaps out of complacency. Investments in agricultural research have been experiencing a declining rate of increase in most countries and in some cases even an absolute decline (see Chapter 3).

CGIAR's Strategic Results Framework, based on a modeling exercise, notes that public agricultural R and D for developing countries would need to increase from the current \$5.1 billion to \$16.4 billion by 2025 – of which the \$1.6 billion would need to be the CGIAR element.

FAO estimates that gross investments for agricultural research, infrastructure and safety nets averaging \$ 210 billion per year are needed to meet food demands by 2050, an increase of almost 50% over current levels (Chapter 4). IPCC similarly estimated the cost of REDD or equivalent schemes at \$10 billion annually compared to the World Bank commitments to such schemes of a few hundred million annually.

Declining Aid and Declining Share of Agriculture and Infrastructure in Aid⁹

Figure 21. Declining Overseas Development Assistance to Agriculture (1979 – 2007).



⁸ The "BRICs Meeting", otherwise known as the "International Workshop on Fast Growing Economies' Role in Global Agricultural Research for Development" was held in Beijing, 8 – 10 February 2010, and was hosted by the Chinese Academy of Agricultural Sciences. Further information can be found on the GFAR website.

⁹ IDA, 2007; Agarwal and Lele, Forthcoming.

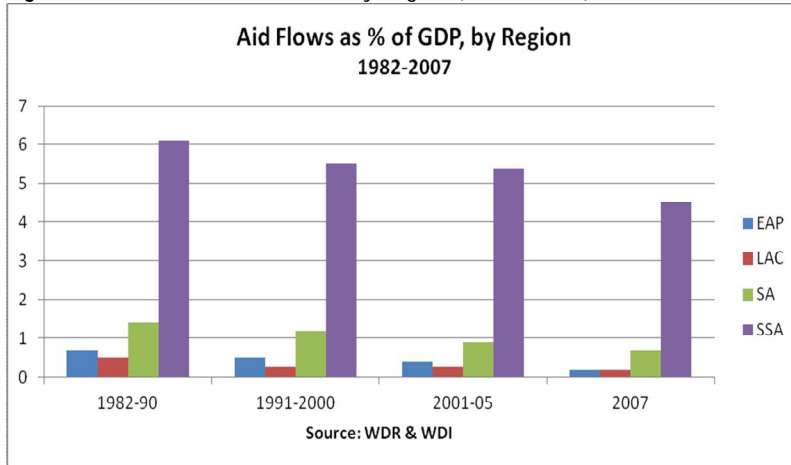
The real aid picture is quite different from the popular perceptions of high level of assistance to developing countries which generally prevails in donor countries. Donors have recently pledged \$20 billion to agriculture in the next three years; there is some evidence that donor aid to agriculture increased in 2008 and 2009 for which data were not available when this paper was being published. And yet, how much of the \$20 billion will materialize and whether these new commitments will result in increased net flows into agriculture and rural development - beyond the three years if there are a few bumper harvests and the problem of agriculture is believed to have been "solved" - remains to be seen.

Analysis carried out on aid flows to developing countries by Agarwal and Lele (forthcoming) presented in greater detail later indicates that over the 1982 to 2007 period, the share of net aid flows (inflows less repayments of past debt) in the total of both public and private flows has become negative for Latin America and for East Asia, and it has declined substantially for South Asia. Even for Sub-Saharan Africa, the importance of aid has declined whether it is considered as share of GDP, investment or imports (see Figure 21, Figure 22, Figure 23, and Figure 24). For South Asia aid as share of GDP was 1.4 % in the 1982-1990 periods but had declined to 0.7% for 2005-2007 periods. For Sub-Saharan Africa the share of aid was slightly over 6% of GDP in the early 1980s but had declined to 4.5% in the 2005-2007 period. Net disbursements increased every decade. But when aid flows are considered on an annual basis a different picture emerges. Net disbursements increased from the early 1980s to the early 1990s but then decreased or remained constant till the early years of this century. There was a very sharp decrease until 2001 and then again net disbursements have been almost constant. Most increases in aid were for humanitarian aid and debt rescheduling. While commitments to agriculture (to countries with a great deal of poverty) increased after the food and the financial crises of 2007 and 2008, the balance of payments support increased considerably to Eastern Europe, overall.

Most of the development aid went to health and education although the share of education too declined over time. The share of aid going to the social sectors has increased while that going for infrastructure and agriculture declined. Productive sectors suffered the most with a decline in the share of agriculture from 10.5% in the early 1980s to less than 4% in the share of aid going to agriculture until it began to show an upturn in 2008. However its long term sustainability depends in part on the demand for aid to agriculture in a demand driven world and in part on the absorptive capacity of agriculture to utilize resources quickly and effectively given that as a sector, agriculture has always been a slow disbursing sector. Even in the case of Sub-Saharan Africa where aid is still significant, aid is less than 10% of all net capital inflows.

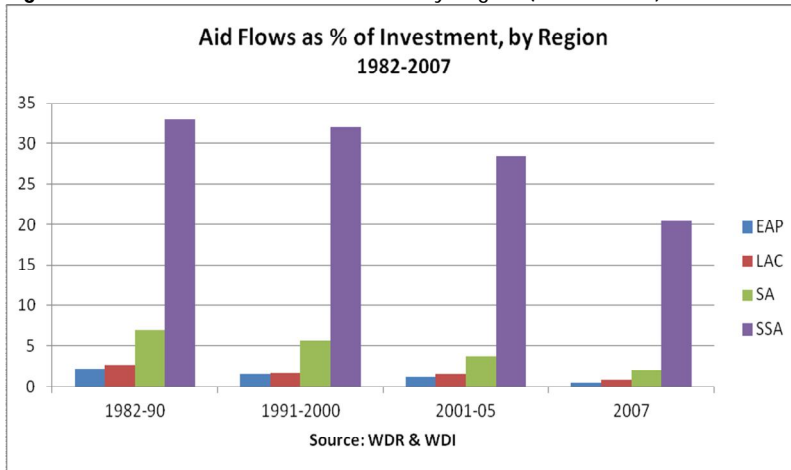
Gross private capital flows on the other hand have increased substantially over the years. These flows seemed to have stabilized at about 10% for Latin America and East Asia. They continue to rise sharply in Sub-Saharan Africa and in South Asia. Continuation of the high rate of growth of FDI into Sub-Saharan Africa will likely depend on whether there would be another commodity boom and whether there is further privatization. The high rates of growth in South Asia are likely to continue to attract private capital. They would increase even faster if more privatization occurred in India. A more recent phenomenon is outward flow of FDI from the large developing countries to other developing and developed countries including to agricultural related investments (Chapter 4). More recently, in response to high agricultural prices and a renewed recognition of the importance of an adequate food supply, funding has begun to trend upward again. CGIAR funding was over \$495 million in 2007, and World Bank agricultural lending increased from an annual average of \$1.5 billion in 2002 to \$4.6 billion between 2006 – 2008 (Wright and Shih, 2010; World Bank, 2009; CGIAR, 2008d).

Figure 22. Aid Flows as % of GDP, by Region (1982 - 2007)



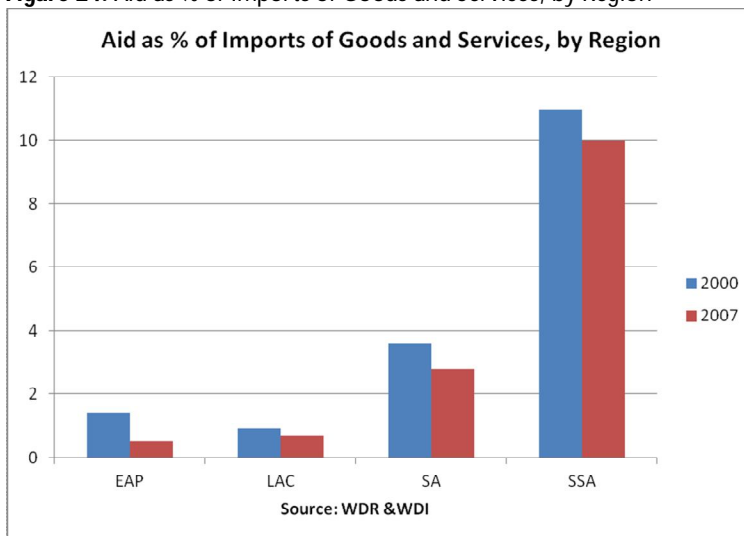
(Agarwal and Lele, Forthcoming)

Figure 23. Aid Flows as % of Investment, by Region (1982 - 2007)



(Agarwal and Lele, Forthcoming)

Figure 24. Aid as % of Imports of Goods and Services, by Region



(Agarwal and Lele, Forthcoming)

Some issues in increasing aid to the agriculture and the rural sector

One of the many reasons why development assistance to agriculture and rural development has been falling is that the transaction costs of preparing and supervising agricultural, rural and forestry projects for investment banks and for governments tend to be higher per unit \$ committed and disbursed - due to their institutional complexity, safeguard issues - among others - relative to lending or providing concessional assistance to large scale infrastructure and urban projects where commitments tend to be larger and disbursements faster.

Development policy loans (DPLs) which have been on the rise for the same reasons for larger and quicker disbursements. Compared with project investment loans, DPLs are more popular with donors and recipients alike. By their nature the fast disbursing development policy loans are weak on the institution and capacity development – two aspects that *are* offered by project lending. On the other hand projects have often been funded and implemented with artificial units created in governments, particularly in Africa, where capacity for implementation has been weaker relative to larger and more developed countries of Asia and Latin America. As a result, scaling up programs and making them sustainable in the normal apparatus of the governments remains a challenge. Often the non-governmental organizations are weak, and multilateral and regional banks only lend to governments. Unless these issues are addressed it is unclear how increased assistance can be effectively absorbed on a large scale (Agarwal and Lele, Forthcoming).

Implications for Development of, by and for the Poor

Recent evidence on development effectiveness gathered by the World Bank's Independent Evaluation Groups indicates that the World Bank has been overoptimistic in its assumptions of what could be delivered in relation to the actual performance of projects and countries (IEG, 2008). It has done best in countries which are already the strongest, namely China and Brazil. The Bank's record in the least developed countries, e.g. such as Malawi which has recently shown great success in food production but where development challenges are still substantial, has been the weakest. It further goes to stress that global public goods are most effectively delivered where there is greater congruence between global and local costs and benefits. Challenges are the greatest when there is considerable divergence between the two. The challenges are particularly the greatest when it comes to environmental global public goods such as climate change, compared to communicable diseases - where local people can see the benefits to themselves immediately and therefore buy into the process (IEG, 2008).

Pardey and Beintema (2001) calculate that the agricultural research resource stock, as a proportion of value of agricultural output, is at least 12 times larger in the United States than in Africa, given reasonable rates of interest and depreciation. Wright and Shih (2010) note that there is mounting evidence that multiple, mutually blocking intellectual property claims on inputs are hindering access to research tools that can be incorporated in the marketed products of agricultural research (Pardey et al., 2007; Wright and Pardey, 2006). The rising application of IPRs to plant components and processes imposes high transaction costs for researchers who must acquire or license fragmented proprietary inputs to develop and commercialize a single downstream innovation.

Agricultural economists have long been concerned that patents on locked-in but otherwise non-crucial genetic technologies have been retarding innovation and affecting the market structure of private research. In the field of plant biotechnology in particular, where ownership of the genes, markers, or promoters incorporated in a single innovation is fragmented, upstream IPR-holders, unwilling to allow commercialization of varieties using their property, have in some instances foreclosed university development of new crops or technologies. The broader economics profession

has become focused on these issues more recently, due to growing problems with blocking patents on embedded software (Wright and Shih, 2010).

In a 2003 *Science* article signed by fourteen university presidents, chancellors, and foundation presidents, the authors highlight the negative effect of intellectual property rights on “freedom to operate” in agricultural research (Atkinson et al., 2003). They note that in fact, universities themselves appear to have contributed to the problem by insisting on the use of material transfer agreements (MTAs) governing exchanges of research materials between researchers, to protect university intellectual property rights and limit university liability.

Going forward these findings may well have considerable implications for the CGIAR’s and the national system’s partnerships with developing countries including for public private partnerships of the CGIAR. We turn to these issues in the chapters that follow.

Chapter 3: The Current Landscape of Agricultural Research for Development (AR4D)

This chapter is aimed at serving three purposes. The first is to describe the sweeping changes in the number and the strength of players in the current fragmented international architecture of agricultural research at the national and international levels. The second purpose is to present a picture of the growing differentiation among the “haves” and “have-nots” of science. The third is to illustrate simultaneously our rather poor state of knowledge about the major players and the funding of this fragmented global architecture. Particularly looking ahead in constructing a new and more integrated global system of agricultural research for development, this poor state of knowledge should be a matter of concern indeed. By necessity, and the reality of the time and resource constraints, this chapter is illustrative rather than comprehensive. The implications of the presence of these many actors for the research priorities of the national and regional systems going forward which have emerged from the consultative processes, the CGIAR's new themes leading to Mega programs, the extent of convergence among and between them and their implications for future programmatic approaches and partnerships are explored in Chapter 5.

A. Institutional Diversification: A Multiplicity of AR4D actors

Today's global agricultural research system is the result of a complex and a very rapidly evolving process of international cooperation among research systems that started in the post World War II period. It involves a number of international efforts aimed at modernizing agriculture in developing countries by transferring technology from the developed countries and integrating peasant farmers into the market economy (Schultz, 1964). This chapter contains a comprehensive review of what we know, do not know and need to know to move towards a more cohesive AR4D system.

This review, though, is hampered by major information gaps. Based on 2000, the latest year for which data are available, the CGIAR constitutes between 4 % of the total global *public* expenditures on agricultural research with about 94 % of the *public* expenditures of the public research systems of developing countries (and 2 percent of the total public expenditures of developed and developing countries combined). But there is much activity beyond the public institutions which is captured in an assortment of recent studies and on websites of donor organizations. It is evolving rapidly, evolving activity, particularly of large emerging countries such as China and India, the multinational and national private sectors, the civil society and the OECD countries, which is impossible to capture in this short report. Some of it involves activity in developing countries. Other is of relevance to developing countries and which foundations and developing countries are in the process of accessing. Currently the global agricultural community lacks sufficient information on this highly diverse but an increasingly important part of the global agricultural research system. Science is advancing very rapidly in OECD countries and much of it is captured in the publications of individual countries, e.g. the US academy of sciences, the Royal Society's recent report (2009) or the tropical research and development institutions of European countries, but there is no comprehensive source even for individual countries from where the water front of such developments could be known (Alberts, 2009). Scientific communities are also surprisingly isolated from a *developmental viewpoint*. Thus what research the North American, European and Japanese scientific communities undertake bilaterally in developing countries through their development assistance is not always well known to others working on similar issues. Besides despite untying of aid, a larger share of the little aid that goes to agricultural research, if it is largely in the form of technical assistance, remains in developed countries and its impacts are neither easy to measure nor clearly explored, unlike those of US investments in research and training in Asia.

Besides far too little is known about the substantial and the growing bilateral research and development activities of emerging economies in developing regions of the sort which were discussed at the BRICs meetings organized in the context of the GCARD process (Kharas, 2008).

Even some of the very valuable information that is available on the public sector research expenditures in developing countries is dated. Since the dissolution of ISNAR, one of the CGIAR centres, which had a long term program to support national agricultural research systems and systematically collected such information, recent information gathering has been more ad hoc and dependent on short term donor support. As part of the transformation process recommended at the end of this report, the report suggest the urgent need to put in place a system which will routinely collect and disseminate such information under the GFAR umbrella, to improve our knowledge of these new and old stakeholders and their changing activities of relevance to sustainable food security and poverty reduction in developing countries.

The goal of international cooperation in the 1960s and 1970s was to increase agricultural production, foreign exchange earnings and savings, and reduce labor in agriculture, all of which could be used for industrialization and modernization (Reynolds, 1975). The conventional wisdom was that agricultural transformation would require little new research. It was assumed that the problem was not lack of knowledge or technology – there was enough known at the international level – but capacities were needed in the national research and extension systems to adapt it to local conditions. In practice, this largely meant conducting variety trials and establishing appropriate doses and forms of application of fertilizers and pesticides with a heavy emphasis on community development programs to persuade farmers to adopt known technologies.

With this view, research units were created, first within the Ministries of Agriculture and then decentralized into semi-autonomous public research institutes or research councils. The aim was to set up institutional structure that was less bureaucratic and more protected from short-term political pressures. Agricultural extension was a part of this institutional novelty in many settings, though it tended to be kept under a separate structure, mostly as operational units within the Ministries of Agriculture. All these initiatives received significant political and financial support both from national sources and from international donors, development assistance agencies and multilateral organizations. Some have called the 1980s the golden decade for investment in agricultural research (Pardey et al., 2006a).

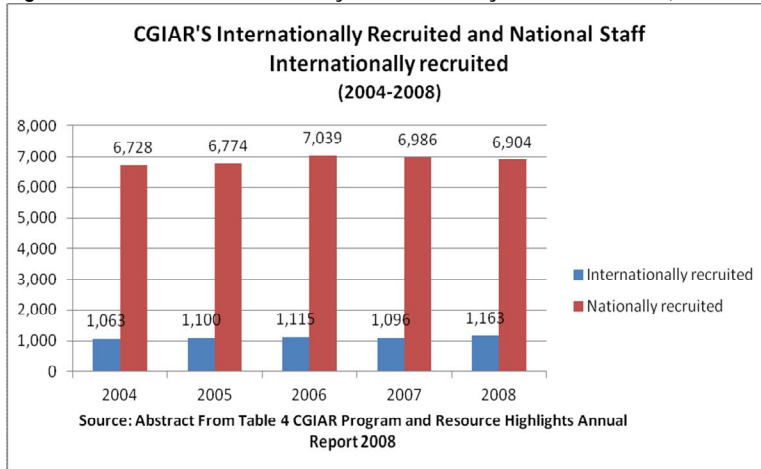
1. Birth of an International System: the Establishment of the CGIAR

From a fascinating history of the establishment of the CGIAR (CGIAR, 2008c), at its inaugural meeting, the CGIAR adopted a simple "Statement of Objectives, Composition, and Organizational Structure." This founding resolution committed the CGIAR to: examine the needs of developing countries for specialized efforts in agriculture; harmonize international, regional, and national efforts to finance and undertake agricultural research; provide finance for high priority agricultural research activities; undertake continuing review of priorities. The CGIAR also established a Technical Advisory Committee, headed by Sir John Crawford, to provide the Group with independent technical advice. In 28 years from the launch of the collaborative effort in Mexico, far-seeing donors had created a unique institution to mobilize science and financial support to serve the needs of the poor.

Today the CGIAR, remains at the centre stage of the international system of research. Its strengths and weaknesses have been well identified in the numerous reviews carried by its principal financiers and in the recent stakeholder consultations the system engaged in as part of the reform process. The strengths include the CGIAR's noble mission and a substantial record of achievement, demonstrated high rates of return on some of its research, its human resources and networks with a coordinating

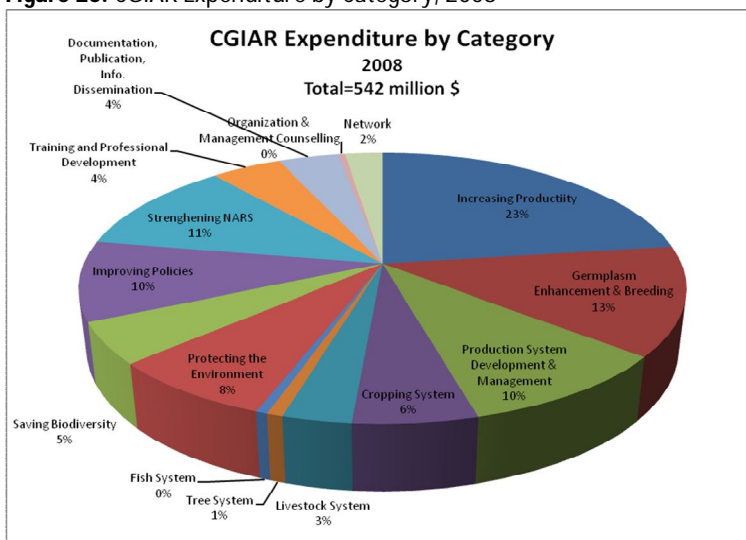
role in working with scientists in developed and developing countries, its breeding expertise and collections of genetic resources, its research and training programs, its honesty, credibility, talent, dedication, and experience of staff (see Figure 25 and Figure 26). Stakeholders also caution however that its human capital is been eroding quickly through reliance on special funding and other financial challenges, caused by short term funding, medium term planning, and too many centers looking for funding with overlaps and competition among them (World Bank OED, 2003a; CGIAR, 2008a) (see Annex A). The CGIAR has been seen by the stakeholders to be too slow change, as gradually having moved away from its mission and research focus, and spread too thinly with a limited presence on the ground (Echeverria, 2009). The IPR issues are also nagging at the margin in the case of its spectacular germplasm work (Wright and Shih, 2010). Given this assessment the recent reforms are welcome; more on it is said in Chapter 5. The importance of its mission and the CGIAR's history of accomplishment provides reason to believe that all stakeholders concerned will act differently than they have since the early 1990s when its financial crisis began, so that this small catalytic organization with only a 1000+ scientists with a giant mission can regain its premier position again particularly by better leveraging the expertise and good will of its research partners.

Figure 25. CGIAR's Internationally and Nationally Recruited Staff (2004 - 2008)



(CGIAR, 2008d)

Figure 26. CGIAR Expenditure by Category, 2008



How did the CGIAR come about and achieve such high returns to investments?

Progress on increasing agricultural production and productivity was limited particularly in Asia in the 1960s and 1970s while many populous countries faced heavy shortfalls in food supplies and were becoming increasingly dependent on food aid. The Ford and Rockefeller Foundations however had been experimenting with plant breeding of wheat, rice and maize in Mexico and the Philippines by cross breeding plant varieties and noted that they could achieve considerable success in increasing productivity by using shorter duration, shorter plants which had demonstrated considerable success in productivity grown in Asia in the 1960s with rice and wheat. Foundations however had no resources to scale up the approach and therefore approached the World Bank and USAID if the international and bilateral organizations would help create an international system of centers with public sector support to scale up their approach. This led to the creation a major international initiative – the creation of the Consultative Group of International Agricultural Research (the CGIAR system). The international centers initially concentrated primarily on collecting, enhancing and distributing improved germplasm with substantial simultaneous emphasis on training national scientists in specific crops and research issues through formal long and short duration training and developing highly effective networks of scientists who could test these approaches and varieties in their countries and provide a regular feedback to the CGIAR centers on the efficacy of the new varieties. The group is now comprised of 15 centers.

Following the same logic used in setting up the semi-autonomous *national* research institutes, in which USAID and the later the World Bank invested heavily particularly in Asia and Latin America, the CGIAR centers were designed to create a critical mass of highly-trained scientists with sufficient resources who could work in a non-bureaucratic setting shielded from political pressures. All these initiatives received significant political and financial support both from national sources and from international donors, development assistance agencies and multilateral organizations. The institutional system that emerged from this process was centralized, top-down, and supply-driven.

Throughout the process, the state played a dominant role in promoting technological change. This role reflected the prevailing views that the state should be the driving force in promoting economic development that the commercial private sector was weak, and that private firms will not invest in the development of technologies whose benefits they cannot capture. The private sector was limited to supplying seeds and agrochemicals where markets were large, and the food processing industry was still in its early stages, heavily dependent on public sector support. Except for a few export crops, private sector research was virtually nonexistent (Pinero and Trigo, 1983).

The institutional system that emerged from this process was centralized, top-down, and supply-driven (Biggs, 1990). Germplasm was collected, improved and tested at the international centers, passed on to the national research institutes for multi-location tests, and then promoted by national extension services and seed firms through demonstration plots. Where private seed companies for grain crops did not exit, with assistance from the Ford and Rockefeller Foundations, USAID and the World Bank some developing countries such as India, established public sector seed companies in which the World Bank invested. The seed market was too small and farmers perceived high risks in adoption, the quality, quantity and timeliness of seed production and distribution had to be assured to encourage farmers to adopt. In the absence of a domestic seed industry India had imported 8 million tons of seed from CIMMYT in Mexico to get the Green Revolution underway (Lele and Goldsmith, 1986). Public extension and credit agencies, and later private firms, sold agrochemicals, veterinary products, breeding stock for cattle, and agricultural machinery and implements. The system was simple and each actor had a clearly defined role, and largely achieved their goals. It succeeded, particularly in Asia, in “building up the pile of rice” and by raising food supplies and their year to year stability, lowered food prices. By creating employment through double and triple

cropping it increased incomes and had a significant impact on reducing poverty while reducing food import dependence (Lele and Bumb, 1994; Lele and Goldsmith, 1986). Agricultural research has had very high rates of returns on investments as indicated in previous chapters.

Recently the initial focus on food availability, production and productivity has become broader, most notably in the CGIAR and to a varying degree in the national agricultural research systems, although the regional consultations noted that like the CGIAR, the research of the national systems too is still narrowly focused on a few crops and without sufficient attention the agricultural activities of the poor, the environment, and natural resource issues. Beyond the need for a wider span of agricultural research activities, national research systems often have to increase their awareness of value chain issues and deal with mobilizing marketing and processing technologies that can accelerate the adoption of a new technology. Thanks to investment in agricultural and rural development that complement agricultural research, German and Japanese rice milling technologies and cold storages for potatoes became ubiquitous in Asia in the 1970s once the new crop varieties were introduced.

With the wider set of challenges, the scope of work of the initial set of national and international research organizations has broadened, and new organizations have been brought into the fold. This has resulted in a landscape of great diversity both in the types and number of organizations and in the ways that R&D activities are organised and funded. They reflect the diverse country and regional characteristics and agro-ecologies, types of agriculture, socioeconomic conditions, economic scales and historical and cultural backgrounds. The following overview of the main components of this evolving system of agricultural research actors highlights the differences among developing regions.

2. Public Sector Research Institutions at the National Level

Public sector institutions still constitute the backbone of the world AR4D system. Whether in the form of national agricultural research institutes, or as agricultural research councils acting as coordinating bodies of specialized, regional or local research institutions, government organizations make up the bulk of research capacities in every region of the world. The agricultural research council concept is the one most prevalent in South Asia and the Pacific (Bangladesh, India, Pakistan, the Philippines, Nepal, Sri Lanka, and Taiwan). It entails a central body mainly responsible for priority setting and funding of research but leaves implementation to other independent bodies. The national institute model on the other hand is more common in Latin America and the Caribbean and, more recently, the African countries. It brings all research under one operational structure. However, this later type of institutions is also present in some Asian and the Pacific countries such as Indonesia, Malaysia, Papua New Guinea, and South Korea.

China, India, Indonesia, Brazil, Mexico, Argentina

While the prevalence of the public sector in the AR4D systems seems to be a common feature across the developing world, there is great variability among the sizes and sophistication of systems. This variety has profound implications for the performance of individual NARS as well as partnerships among them and with the CGIAR. Some of the larger countries – China, India, Indonesia, Brazil, Mexico, Argentina, among others – now have highly developed and complex structures whose capacities and growth in some specific areas has surpassed the capacity of even some developed countries, but the smaller NARS barely have the minimum capacities to act individually. The Chinese agricultural research system with more than 80,000 scientists and the highest number of agriculturally related patents, for example, while highly centralized until recently, was in the process of reorganization of its system when this paper was being completed. The reforms involved a number of different structures such as the Ministry of Agriculture's Chinese Academy of Agricultural Sciences (CAAS), the Chinese Academy of Fishery Science and the Chinese Academy of Forestry,

along with their associated institutes, and a number of academies and provincial government-sponsored agricultural research institutes, focusing on local issues and conditions (Yinlong et al., 2009).

In India, the Indian Agricultural Research Council, ICAR, overseeing a system of 26,000 scientists involves more than 90 different research institutes with independent disciplinary, crop, and ecoregional mandates; however, with the development of the land grant universities two-thirds of the agricultural scientists are in agricultural universities (Singh, 2010). The US supported training 1,000 Indian agricultural scientists and that now work in its 42 agricultural universities, the ICAR and the CGIAR.

Brazil, the largest of the LAC countries, has a two-tier system of federal- and state-based agencies, with the Brazilian Agricultural Research Corporation (EMBRAPA), a semiautonomous federal agency administered by the Ministry of Agriculture and Food Supply, as the apex of a system that includes 37 research centres throughout the country (Filho et al., 2009). In addition to that structure, 16 of Brazil's 26 states operate state agricultural research agencies, although most state-level activities are carried out in São Paulo, the largest of the country with 64 experiment units and 43 research laboratories of its own. The Research Centre for Cacao (CEPEC) and the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) and a number of (mostly federal and state) universities complete the network of capacities in the AR4D area in addition to some research in universities and the private sector. The picture in Mexico and Argentina is similar. EMBRAPA's budget of \$1 billion was nearly twice that of the CGIAR in 2009 with international collaborations ranging a number of developed and developing countries. In Mexico, government-led agricultural R&D is overseen by National Institute for Forestry, Agricultural, and Animal Husbandry Research (INIFAP), a large organization with eight regional research centres (CIRs) spread over the country, as well as five national disciplinary research centres (CENIDs), that attend to a broad range of agricultural R&D needs at the regional level. In Argentina, the central role is played by the National Institute of Agricultural Technology (INTA), which is the major government agricultural R&D agency, but a large number of agencies under the National Scientific and Technical Research Council (CONICET) also undertake scientific research covering a broad and heterogeneous spectrum of both agricultural and non-agricultural disciplines.

The small countries NARS and the need for options

Agricultural science output from these countries is increasing very rapidly and they now rank among the world's largest providers of agricultural research knowledge. At the other extreme of these large and complex research institutions are the national systems of a majority of the smaller countries in the developing world. They need to serve a diverse range of demands and research needs comparable to those in larger NARS, but with structures lacking the minimum necessary capacity in many of the key agricultural disciplines, except perhaps certain types of adaptive research. This is the case in most of the countries in Sub-Saharan Africa as well as in Central America. In these cases, most countries have one research organization, and are frequently grossly understaffed and under-resourced. In sub-Saharan Africa in 2000, 93% of the region's agricultural R&D agencies employed fewer than 50 researchers, and 40% of them employed fewer than five full time-equivalent researchers (Beintema and Stads, 2004a; Eicher, 2009; Mokwunye, 2009).

Looking ahead it is clear that addressing the small country agricultural research and technical skills problem is central to any successful strategy for assuring food security and reducing poverty with the help of agricultural research. The implications of this go well beyond research itself. Skilled technical knowledge is now an essential component of trade, through both subjective measures such as Good Agricultural Practice and explicitly-defined measures such as the International Plant Protection

Convention and HACCP. However, the strategy today will be significantly different than the past. The emergence of China, India, Brazil and other emerging countries with their research power houses, opens a whole host of new opportunities for south–south cooperation on the basis of shared interest, concerns and experiences among countries that are closer both in agro ecological and socioeconomic terms. Emerging countries are already engaged in such activities. Brazil has opened an office in Accra (Ghana) with an aim of promoting scientific cooperation between Brazilian and African NARS including universities, and China has set in place a number of programs to help building human capital systems with African teachers and researchers; some African countries are currently receiving more graduate scholarships from China than from any other country. India has similarly increased its exchange programs with African and Latin American agricultural research and educational institutions. The same is occurring in other parts of the world, such as Central America, where EMBRAPA is opening a regional office to work directly in the field to improve Central American AR4D efforts.

3. Institutions of Higher Education

Higher education institutions have been increasing in numbers and their importance within the AR4D landscape over the last decades and in some cases they actually represent a larger capacity – in terms of human resources – than other public research institutions. But information on the role of universities is more limited than what is available for national agricultural research systems; this knowledge gap about their current status and likely future roles needs to be filled. Because they differ greatly in quality, they provide a major opportunity for the transformed AR4D to help upgrade their capacities. In Latin America and the Caribbean region a number of countries (among them Argentina, Costa Rica, Mexico, Honduras and Uruguay), universities represent over 40% of the countries' research capacities (Stads and Beintema, 2009). In Africa there is a similar tendency and the importance of universities has more than doubled between 1970 and 2000 to about 19% of total capacities (Beintema and Stads, 2004c). However as Eicher notes, there are around 200 public universities on the African continent, with approximately 100 of those offering courses in Agriculture; there is an urgent need to create true centers of excellence among this group. Which universities to select by what criteria to turn them into centers of excellence is a major strategic issue for AR4D (Eicher, 2009).

In Asia the picture is less clear in terms of trends - in part due to lack of data for all but a few countries - but still universities seem to be important. In India, where the land-grant system of integrating education, research and extension has been adopted, universities employ more researchers than in the government sector. The issue with universities within the AR4D system of developing countries (unlike counterparts in the USA), is the focus of university research, on more academic and disciplinary-oriented, with less emphasis on applied issues of direct relevance to agricultural problems in general and for small holders agriculture in particular although again there is considerable difference among them. Some universities and specific departments among them tend to be close to farmers and others less so. In general, faculty staff at most higher education agencies devotes their time to teaching, with research being a secondary activity. They nonetheless hold a key role in capacity development and with appropriate support for their growth and development to applied agricultural research.

4. The Private Sector

Private R&D fosters innovation and productivity gains in agriculture in both rich and poor countries. Yet our knowledge of the full scope of the work the private sector is doing directly on developing countries or work which is relevant to the needs of the poor is very limited because there has not been a concerted *global* effort of the kind that the Bill and Melinda Gates Foundation have

undertaken in the case of vaccines to assess what kind of research and development needs to take place in food security, agriculture and environmental management, and what role the private sector might be able to play in this process although there have been a number of such initiatives on a regional basis (e.g. AGRA) and several others reported in this paper. Those reported are in the areas of crops. But there are also a number of technologies in the private sector on water (on desalinization and drinking water), climate change (e.g. new carbon funds in the World Bank in which the private sector is investing and related to which a great deal of (scientific) research should be underway).

Studies attest to the positive impact of private agricultural research by Indian seed companies on crop yields and farm profits in that country. Econometric studies cited by Pray et al. (2007) demonstrate (i) that increases in the use of manufactured agricultural inputs developed and sold by the private sector added to average annual agricultural growth in Asia and Latin America, but not in Africa, and (ii) that private research had the effect of increasing agricultural output by raising total factor productivity when the *quality* of inputs improved such as when breakthrough chemicals and varieties of seed or machinery were developed and diffused. Ferroni (2010) reports that assessments of total factor productivity in Indian agriculture that looked at the relative contributions of public and private agricultural research found positive private contributions, but they were smaller than those derived from public R&D.

The role of the private sector in agricultural research in the developing world has evolved rapidly from its initial involvement with a few export crops in the post world war period to become a key player in the supply of genetic technologies and seeds, agrochemicals, veterinary products, agricultural machinery and implements. In most cases, however, their efforts, both by multinational as well as by national input supply firms, are concentrated in the commercial agriculture sector where the market and institutional conditions to assure appropriate rates of returns for their investments are present, and thus their focus is mostly on the near the market end of the R&D spectrum (Mignouna et al., 2008).

This trend is particularly present in Asia and Latin America, but smaller in Africa. But even in Africa it is increasing, particularly in some of the larger countries and with respect to certain market segments. In a number of Asian countries (such as India, Philippines, and Indonesia), the private sector presence is significant share of spending - reaching 15% of total (public and private) in agricultural R&D (Singh, 2010). Most of these investments are directed to plantation crops (oil palm, coconut palm, sugarcane, and rubber), where financing of private sector R&D is mostly from export levies and promotional instruments such as investment tax allowances and tax exemptions. Nonetheless, it should be noted that these models do have a significant strength absent in most staple crops, in that they often have direct accountability for research and its responsiveness to farmers. There have been attempts such as in Uganda's National Agricultural Research Organization (NARO) and National Agricultural Advisory Development Service (NAADS), to provide funds direct to farmers to commission the services they seek, but these are not yet commonplace elsewhere.

Recent private investments, in India and the Philippines, have been directed to biotechnology research. A good example is the Mahyco Maharashtra Hybrid Seeds Company, the first Indian company commercially to grow and market transgenic Bollgard cotton in 2002 – India's first transgenic crop. Private sector participation in Chinese agricultural research has also increased, with some estimates placing private investment at about 9% of total research investments in 2003, although many of the firms involved were still at least partially state-owned. Researchers analyzing China's impressive agricultural productivity growth attribute at least a part of this growth to borrowing technologies from private companies (Jin et al., 2009).

In many countries, including India and China, there are active policies to provide further incentives for the private sector becoming a larger actor agricultural research (Singh, 2010). However, unlike in China and Brazil private sector involvement is also intensely controversial in several developing countries because it is associated with GM technologies. At the time of completion of this report, the US government's developments on the labeling of genetically modified salmon and the use of genetically modified sugarcane reflect both the complexity as well as the highly evolving nature of the legal aspects of the new technologies. These events stress the importance of an objective platform that can transparently inform the public, ensuring that existing knowledge is deployed and that help is provided to countries to develop clear, credible technology policies which can command well informed ownership among in-country stakeholders.

This calls for major improvements in technology policies in developing countries. Middle income countries such as Brazil, Argentina and China are more advanced in putting in place technology policies than India or Mexico. Their political systems also enable them to more effectively harness knowledge that exists externally than other countries such as India (Pehu and Ragasa, 2007).

In Latin America and the Caribbean, what little information exists on the activities of the private sector suggests that private sector involvement is less significant than in Asia, even though there is a long experience with producer and export levies based systems - coffee, sugarcane, oil palm, cacao, cotton, and other crops. LAC agriculture is technologically advanced, and is serviced by a sophisticated system of private input supply, post-harvest handling, and processing. Therefore estimates place total private participation at a level below 5% of total investments seems surprising given that many countries in the region (Argentina, Chile, Paraguay, Uruguay, Brazil, Colombia, and Peru) also have significant publicly-supported programs to promote private participation in their agricultural research efforts (Stads and Beintema, 2009). As in the case of Asia, this overall picture also hides very different situations. In some of the large countries – and also in a number of the smaller with stronger economies and international market integrated agricultures, such as Colombia, Chile and Uruguay among others – there are a number of important private led initiatives, particularly in the area of seeds, animal health technologies – diagnostics and vaccines – and biotechnology applications. In most of this countries a significant proportion of plant variety and veterinary vaccines development is in the hands of the private sector and most of the GM work in soybeans, maize and cotton, is linked to multinational corporations, although many of it is through joint ventures with local firms. The private sector is also a significant actor in technology development in the fruit sector in Chile (Piñeiro and Trigo, 1996; Trigo et al., 2010).

Most of the existing private R&D investments in Africa are from non-profit institutions receiving their funding via levies on production or exports. These include agencies conducting research on tea (Kenya, Tanzania, and Malawi), coffee (Uganda, Kenya, and Tanzania), cotton (Zambia), cotton (several West African countries) and sugar (Mauritius, South Africa). Research of non-food crops was substantial and of high quality in Africa in the past (Eicher, 2009; Lele, 1975, 1991), but most such research has suffered during the reform processes of the 1990s which dismantled some of the marketing boards to which the financing for research was linked. There are also non-profit institutions in a number of countries, including Madagascar and Togo, although they play only a limited role in agricultural research, accounting for a very small proportion of the research effort (Mokwunye, 2009).

Box 4. Water Efficient Maize for Africa (WEMA)

Drought is the most important constraint of African agriculture severely affecting maize, the most important African staple food crop. Three-quarters of the world's severe droughts over the past 10 years have occurred in Africa. One of the most important public-private agricultural technology partnerships – the Water Efficient Maize for Africa (WEMA) partnership - was recently created in response to a growing call by African farmers, leaders, and scientists to address the effects of drought in a way that is cost effective to African smallholder farmers. The aim is develop drought-tolerant African maize using conventional breeding, marker-assisted breeding, and biotechnology, and to make this maize available royalty-free to small-scale farmers in partner countries - Kenya, Mozambique, South Africa, Tanzania, and Uganda. It uses the two core platforms of Monsanto's technology pipeline, namely, breeding and biotechnology, to develop breeding stock, and genetic traits to enhance a plant's characteristics, such as producing insect resistance, herbicide tolerance and drought-tolerance (Oikeh, 2009).

5. Public Private Partnerships

A key issue in private sector participation centers on public-private partnerships (PPPs). These are aimed at joining effort to exploit better each partner's areas of strengths. These types of mechanism are increasingly becoming effective means of conducting advanced research, commercializing new technologies, and deploying new products for the benefit of small scale resource-poor farmers, food insecure consumers and other marginalized groups in developing countries. They commonly involve collaboration between national and international public and private sector entities in which partners jointly plan and execute activities with a view to accomplishing mutually agreed-upon objectives, while sharing costs, risks, and benefits. Relevant examples of this type of arrangements include as diverse undertakings as the developments of new GM varieties – EMBRAPA and BASF in the case of soybeans and Monsanto and China in cotton, maize and soybeans – or the more common agreements between NARIs and universities to undertake with local and multinational firms downstream breeding and variety commercialization.

PPPs are also growing at the international level involving multinational firms and CGIAR centers. Ferroni (2010) describes recent examples (see Table 1) of public-private partnerships in international agricultural research aimed at better use of advanced genomics, molecular biology and breeding methods. As an example, the Syngenta Foundation for Sustainable Agriculture brokered an agreement between Syngenta (the Corporation) and CIMMYT in 2009 to cooperate on breeding for resistance to Ug99, the new, virulent strain of stem rust (a fungal disease) that threatens the global wheat harvest and requires stepped-up research to find sources of resistance and breed varieties that can cope. The project seeks to identify and map genetic markers for use in wheat resistance breeding, combining Syngenta's genetic profiling expertise with the strengths of CIMMYT's extensive field research to develop a genetic map of wheat stem rust resistance. The marker data will be published, and will thus be in the public domain and be used by others without restriction, and breeding products, in turn, will be marketed by each partner in its geographies and markets. Other initiatives along the same lines include germplasm exchange and collaborative evaluation and training with several leading USA maize companies; a Latin American Program funded by Pioneer to evaluate maize germplasm in genebanks in the region; and discussions in progress on a tripartite agreement involving CIMMYT, Monsanto and the Kenya Agricultural Research Institute (KARI) as the lead institute for an evaluation of *Striga* control using herbicide resistant maize in Kenya.

Table 1. Recent Examples of Public-Private Partnerships in International Agricultural Research

Project/ Partnership	Date announced	Partners	Objectives
Rice science exchange and collaboration programme	December 2009	Bayer CropScience International Rice Research Centre (IRRI)	To strengthen rice productivity by utilizing rice genetic diversity, development of diagnostic tools for seed-borne bacterial leaf blight, monitoring greenhouse gas emissions from growing systems, and capacity building for young rice scientists.
Wheat rust resistance research partnership	August 2009	Syngenta International Maize and Wheat Improvement Center (CIMMYT)	To rapidly identify and map genetic markers to support wheat resistance breeding against Ug99 stem rust (<i>Puccinia graminis</i>). This fungus is causing devastating crop losses and spreading across Africa, Asia and Middle East.
Boosting rice yields - science exchange programme	March 2009	DuPont International Rice Research Centre (IRRI)	To strengthen and accelerate breeding efforts and commercialisation of higher yielding hybrids, with added resistance to brown plant hopper. To boost the quality and diversity of hybrid rice in Asia. Doctorate scholarship programme for rice scientists for Asia.
Water Efficient Maize for Africa (WEMA) Multilateral consortium led by AATF	March 2008	Monsanto International Maize and Wheat Improvement Centre (CIMMYT) African Agricultural Technology Foundation (AATF) National Agricultural Research Systems (NARS) in five African countries	To use marker-assisted breeding and biotechnology to develop African maize varieties with the long-term goal of making drought-tolerant maize available royalty-free to African small-scale farmers.

(Ferroni, 2010)

The African Agricultural Technology Foundation (AATF), an initiative of the Rockefeller Foundation, USAID, the UK' Department for International Development (DFID) and a group of African stakeholders, is also an attempt to further PPPs and better exploit the strengths of the private sector. AATF is a unique facilitative organization that operates by creating partnerships with existing organizations, offers opportunities for access to the most advanced agricultural technologies held by multinational corporations and other research institutions on a royalty-free basis. Its mandate is to handle intellectual property management, regulatory compliance, liability and licensing, sub-licensing, and freedom-to-operate assessments (AATF, 2003).

These partnerships naturally pose implementation issues, a number of which are non-trivial. These include the knowledge of just what products and services are available from the private sector for the benefit of small farmers. need for agreement on the sharing of germplasm, open access to data, implementable approaches to market segmentation, arrangements to deal with stewardship and liability in the case of transgenic crops, market analysis, and performing routes to market and the farmer. Further challenges centre on the development of technologies and management that contribute to sustainable intensification, thereby reducing harm to environmental services.

6. Regional Research Associations and Networks of Developing Countries

There has been a significant increase in international agricultural research associations at different levels and in new networks. Among the advantages, they aim to complement national agricultural research infrastructures and help capture technology spillovers across geographical and national boundaries, and in the case of the small countries can become significant resources towards lifting some of the diseconomies of scale limitations they confront. These types of institutional mechanisms are present in all regions and they represent a major actor in the current AR4D landscape and potentially an extremely important, but as yet untapped resource for collaboration in a future transformation strategy. But some have been far more successful in regional cooperation than others.

There are three main types of regional associations and networks (Trigo, 1993):

- i) The first type is the institutional associations, bringing together research institutions from different countries within developing regions, to interact at the institutional level. Interactions may include general exchange of information, the coordination of their research efforts in different issues and training.
- ii) The second type, also at the institutional level, goes beyond cooperation and exchange of information on the basis of what each participating institution/country is already doing as part of their on-going programs, to include the identification of issues of common interest and the development of specific program and projects to deal with them.
- iii) Finally the networks mostly bring together individuals of different institutions and countries with common working interests. Networks have a varying spatial definition and the bonding element is the issue at stake; they can be defined by disciplinary interests, commodities or products, or given issues.

Networks with regional and country hubs that attempt to use global best practices should likewise be added to this list; a prime example of this arrangement is the Global Water Partnership (GWP), which utilizes such a structure to achieve integrated water resource management. The regional and country partnerships vary in their strengths, thus it is an approach which is not without its critics for being insufficiently linked to research or policy.

GAT's Landscape "Inventory" of the current global AR4D infrastructure approach had to be modified significantly to benefit from the regional reports. Rather than producing a straightforward descriptive narrative of the landscape, most of which is already contained in the regional reports, the GAT adopted a strategic approach of analysis, so as to also address GAT's TORs on what mechanisms and partnerships are required to translate research outputs to development impacts, and how the barriers and bottlenecks identified by regional consultations and GAT should be overcome with investments, policies and capacities. In Chapter 5 GAT has summarized the needs and priorities of each region as reported through regional consultations. In this chapter, the description of the regional associations provided below is meant to be complementary to and derived from regional consultations, and aims to identify issues that will help define future individual and collective action need to transform AR4D. Materials from the regional and sub-regional AR4D structures, presented in this report in a synthesized form later, are also available in more detail on the GCARD website.

Asia-Pacific

The largest region in terms of population (see Figure 1, Chapter 1) has a wide number of associations related to agricultural research. Prime among these is the Asia-Pacific Association of Agricultural Research Institutions (APAARI), established in 1991 with the aim of promoting "the development of national agricultural research systems in the Asia-Pacific region through facilitation of intraregional, inter institutional, and international cooperation." APAARI membership includes the NARS of 20, countries from South Asia, South-East Asia, North-East Asia and the Pacific, including Australia, Japan, South Korea and Taiwan China, as well 18 associate members comprising most of the GIAR centers, the Asian Vegetable Research Center, ARVC, and regional and global agricultural producers organizations, and a number of affiliate and reciprocal members, such as the Asia-Pacific Association of Forestry Research Institutes, APAFRI, the Asia-Pacific Seed Association, APSA, the Network of Aquaculture Centers in Asia-Pacific, NACA and the Asian Institute of Technology (Singh, 2010).

The APAARI network works to promote the exchange of scientific and technological knowledge; the improvement of research capacity; and strong linkages across national, regional, and international partners, through an operational strategy covering seven main areas, which include (i) regional

collaboration on priority programs (collaborative research among member countries, through network development and support) (ii) networking of centers of excellence (data bases and electronic connectivity), (iii) human resources development (supporting NARS programs, APAARI fellowships and post-doctoral program), (iv) policy advocacy (policy papers), (v) promotion of technology transfer (publications, newsletters, success stories, workshops and seminars), (vi) resource generation (World Watch and stimulating the interest of non-traditional), and (vii) publication enhancement (supporting all other areas) (APAARI, 2010).

At the operational level APAARI and its partners have been active in the development and support of a large number of regional and subregional networks covering a diverse thematic agenda, including among others the Alternatives to Slash-and-Burn Programme (ASB), the Asia and Pacific Regional Network of the International Network for Improvement of Bananas and Plantains (ASPNET), the Asia Forest Network (AFN), the Asian Network on Sweet Potato Genetic Resources (ANSWER), the Asian Rice Biotechnology Network (ARBN), the Cereals and Legumes Asia Network (CLAN), the International Coconut Genetic Resources Network (COGENT), the International Network for Genetic Evaluation of Rice (INGER), the Regional Co-operation in Southeast Asia on Plant Genetic Resources, the Regional Network for Conservation and Utilization of Plant Genetic Resources in East Asia (EA-PGR), the South Asia Vegetable Research Network (SAVERNET-II), the Southeast Asian Network for Agroforestry Education (SEANAPE), the Southeast Asian Sustainable Agriculture Knowledge Network (SEASAKNet), the Tropical Asian Maize Network (TAMNET), and the Underutilized Tropical Fruits of Asia Network (UTFANET), among other initiatives (Singh, 2010).

Latin America and the Caribbean

The region with the most resources and advanced modern agriculture and relatively small incidence of poverty also has complex regional and sub-regional AR4D structure, with the Forum of the Americas on Agricultural Research and Technology Development (FORAGRO), and the Cooperative Research and Technology Transfer Programs (PROCI) representing the most important institutional features. FORAGRO is the apex body of the system, bringing together all of the relevant stakeholders of the AR4D regional system. The PROCI are partnerships among the national agricultural research institutes of the countries in the sub-region aimed at implementing collaborative activities and joint research efforts on issues and problems of common interest. These initiatives have a strong concentration on institutional development and strengthening, formulating and coordinating projects, transferring technologies, and promoting networking on specific topics, and have been in continued operation for more than 40 years since the late 1960s-early 1970s. The oldest of these programs is the Cooperative Program for Agricultural Research in the Southern Cone, PROCISUR, created before 1970 to serve the LAC Southern Cone's countries (Argentina, Bolivia, Brazil, Chile, Paraguay, and Uruguay). Later on and following the same institutional approach four other regional programs have been put in place to serve the mountainous areas of Bolivia, Colombia, Ecuador, Peru, and Venezuela (PROCIANDINO), to promote and coordinate R&D efforts in the tropical regions of Brazil, Bolivia, Colombia, Ecuador, Peru, Surinam, and Venezuela (PROCITROPICOS), to address the needs of the Island States in the Caribbean (PROCICARIBE) and to network the research efforts of the countries in the Central America and Panama region (Central American Integration System for Agricultural Technology: SICTA). Overall these initiatives are widely regarded as a valuable institutional resource for the countries in the region as they promote and facilitate their participating countries pulling together their human and financial resources to work on shared concerns. Over time these cooperation mechanisms have become increasingly outward-looking and now also include other public and private partners in their activities (Filho et al., 2009).

The LAC regional AR4D landscape is completed by three other major components, the Regional Fund for Agricultural Technology (FONTAGRO), the Agronomic Center for Research and Education in the

Tropics (CATIE) and the Caribbean Agricultural Research and Development Institute (CARDI). FONTAGRO is an alliance of LAC and other countries and donors, to support research and innovation in the agricultural sector of the LAC region through funding collaborative projects on key regional issues (FONTAGRO, 2010).¹⁰ CATIE and CARDI are country owned subregional research implementing and coordination facilities serving the small countries of Central America and the Caribbean islands states respectively (CATIE, 2010; CARDI, 2010).

Sub-Saharan Africa

Sub-Saharan Africa's regional efforts are unique because they are implemented within the Comprehensive Africa Agricultural Development Programme (CAADP) which has been designated the key platform for food and agricultural development. CAADP has been endorsed by the African Heads of State and Government as a framework for the restoration of agriculture growth, food security, and rural development in Africa. The primary CAADP goal is agriculture led development that eliminates hunger, reduces poverty and food insecurity, opening the way for export expansion. To achieve this goal, African governments have agreed to increase public investments in agriculture by a minimum of 10% of their national budget, and to raise agricultural productivity by at least 6%.

The CAADP has laid out the priority areas for action and investments to stimulate and sustain improvement in Africa's agriculture, food security and trade balances. The four priority areas for action, known as the four pillars are: (i) programs to extend the land under sustainable land management and reliable water control systems; (ii) programs that improve rural infrastructure and trade-related capacity for market access; (iii) programs that increase food supply and reduce hunger; (iv) programs that promote agricultural research, technology, dissemination and adoption; the AR4D agenda for Africa is embedded in this CAADP Pillar – agricultural research for technology generation, and the ultimate dissemination and adoption of those technologies.

At the continental level the coordinating organ for CAADP pillar IV is the Forum for Agricultural Research in Africa (FARA). FARA fulfils this mission by providing network support functions (NSFs) to the SROs so as to strengthen Africa's capacity for agricultural innovation. The NSFs are in advocacy and resource mobilization; information and knowledge management; policy and markets; capacity strengthening; and partnerships and strategic alliances. These are congruent with the priorities and strategic objectives of its constituent sub-regional organizations (SROs): namely ASARECA (for East and Central) CORAF/WECARD for West and Central; SADC/FANR for southern; and AARINENA for North. All of Africa's AR4D activities relating to agricultural innovation are implemented in partnerships with the Sub-Regional Organizations (SROs). AR4D implementation for economic impact is coordinated in partnerships with the Regional Economic Commissions (RECs): ECOWAS for the West, COMESA for East and Southern, and SADC for Southern Africa (Mokwunye, 2009).

There are considerable ecological, social, economic and other variations between and within member nations in the African continent, and research priorities are therefore best set at the national level. Yet the SROs have established guidelines on investment options that cut across national boundaries. The sub-regions are thus divided into "Agricultural Development Domains", and within these domains, widespread consultations result in generally acceptable sub-regional priorities. FARA has also developed a number of "time-bound" activities that are implemented by the SROs in support of the CAADP agenda:

¹⁰ Since its inception in 1998, it has supported a portfolio of 65 projects for a value of \$20 million (plus close to \$65 million in counterpart funding) (FONTAGRO, 2010; Mateo, 2010).

- The Regional Agricultural Information and Learning Systems (RAILS) is an African Development Bank (AfDB)-funded project that is designed to fill current gaps in the rural community-NARS-regional-continental-global information chain.
- The Dissemination of New Agricultural Technologies in Africa (DONATA) project is also an AfDB-funded project that aims to “capture relevant lessons and develop effective trans-boundary partnerships and investments for the dissemination of high-potential technologies”.
- The Strengthening Capacity for Agricultural Research and Development in Africa (SCARDA) is a DFID-funded project that aims to overcome weaknesses that affect the capacity of NARS to conduct and manage agricultural research.
- Building Africa’s Scientific and Institutional Capacity (BASIC) is aimed at strengthening African Universities’ capacity to build the scientific manpower that Africa requires for endogenously-driven innovation systems.
- The Sub-Saharan Africa Challenge Programme (Sub-Saharan Africa -CP) is a multi-donor-funded programme that uses the Integrated Agricultural Research for Development (IAR4D) approach in place of the traditional ARD approach that relies on a linear research-extension-adoption approach. IAR4D draws upon innovation and uses a systems perspective as its organizing principle.
- The Partnership for Africa-European Partnerships for Agricultural Research and Development (PAEPARD) seeks to strengthen African AR4D stakeholders’ capacity to participate in European-led development initiatives for Africa and to create more responsive development for Africa.

Many of these initiatives are implemented through collaborative arrangements with different civil society organizations, including NGO groups, farmers associations, and the Pan African Agribusiness Consortium—a network of networks involving national and sub-regional associations of producers, input suppliers, marketers, transporters, processors, research systems, financiers and exporters as well as corporate enterprises to improve agricultural productivity and the competitiveness of Africa’s agriculture (Mokwunye, 2009).

Alongside the above efforts exists the Alliance for a Green Revolution in Africa (AGRA), an initiative jointly-sponsored by the Rockefeller Foundation and the Bill and Melinda Gates Foundation. It is working to establish a regional platform for both research and extension, and its strategy includes three programs: seed systems, soil health and markets. Many of these initiatives are implemented through collaborative arrangements with different civil society organizations, including NGO groups, farmers associations, and the Pan African Agribusiness Consortium—a network of networks involving national and sub-regional associations of producers, input suppliers, marketers, transporters, processors, research systems, financiers and exporters as well as corporate enterprises to improve agricultural productivity and the competitiveness of Africa’s agriculture (Mokwunye, 2009).

Western Asia and Northern Africa

AARINENA is the apex body that brings together research efforts and organizations from the Arabian Peninsula, the Maghreb, the Masreq, the Nile Valley and Red Sea, and Western Asia. AARINENA emphasizes the coordination of national efforts in these areas and operates mainly through specific thematic networks, and has established initiatives for date-palm, cotton, olive, medicinal plants, water use efficiency, agricultural biotechnology, and plant genetic resources. The major development goal of all the governments in the region is to improve the living standards of the people, although public agricultural research strategy, like much of the overall development strategy had neglected the needs of smallholders, and producers who operate at the margins. The AR4D focus is currently

on the poorest in the region with special emphasis on achieving the Millennium Development Goals (AARINENA, 2010).

Established in 1985, its aim was to “contribute to the enhancement of agricultural and rural development through fostering agricultural research and technology development”. The association promotes the exchange of scientific and technical experience and knowledge and partnership through four thematic commodity networks and 3 cross cutting networks supported by a Regional Agricultural Information System (RAIS). The association covers 28 countries and focuses on the establishment of cooperative research and training programs for the development of agricultural research in the WANA region. Of its total research effort, 43% is directed to crops, 32% to livestock and the remaining research focuses on food technology & nutrition and natural resources management disciplines.

Seven major AR4D challenges have been identified as regional priorities to enhance regional integration and food security as follows: Food, security with sustainable productivity of agriculture in the irrigated and rain-fed less favored areas; Improvement of the declining living standards and livelihoods of farmers, with special focus on promotion of welfare for rural women in agriculture; Protection of the environment, especially land and water resources and range land from degradation, special challenges relating to climate change and desertification; technology, information, knowledge and innovations, with improved extension systems to create linkages with farmers, researchers and civil society organizations; markets and marketing to link smallholder producers with retailing and super-markets ; and the enhancement of energy security compatible with the economy and ecology (El-Habbab and Smets, 2010). As part of the regional review AARINENA has attempted to set priorities, with broad stakeholder involvement beyond the NARIs

Central Asia and the Caucasus

The region consists of five countries in Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) and three in the Caucasus (Armenia Azerbaijan and Georgia), is endowed with a large geographical area of 419 million ha (M ha) consisting of irrigated land, rangelands, mountains and deserts. The eight countries of the region attained independence after the breakdown of the former Soviet Union in 1991.

The main development goal of all the CAC countries after independence has been and continues to be to improve the wellbeing of their people. The countries have also now realized the important role the agricultural can play in reducing poverty especially in the rural areas, enhancing food security, and improving the ecological environment. They further the potential role for agriculture in providing sustainable livelihoods for the vast majority of the population that live in rural areas and mountains and also to some in urban areas in the CAC countries.

The region has tremendous potential for agricultural development in its eight countries because it has the required institutional infrastructure and human resources. It has a heritage of traditional agricultural practices and genetic wealth (both plants and animals), and also vast arable areas and rangelands. Thus its potential for future agricultural development in crop production (food and commercial), livestock (both small and large ruminants for meat and milk and milk products), horticulture (fruits, vinery and vegetables), fisheries and agro-forestry is enormous.

The priority areas of AR4D as identified in the 2009 GCARD review process by the Central Asia and the Caucasus Association of Agricultural Research Institutions (CACAARI) could be grouped into five categories: (i) Institutional issues, (ii) Research issues, (iii) Policy issues, (iv) Environmental protection issues, and (v) Socioeconomic issues. Among the institutional issues, agricultural extension was on

the top of the list followed by agricultural research and education, and linkages, partnerships and collaboration. Among the research issues per se included improved technology for sustainable crop production; Water and irrigation management; Livestock research including rangelands; Horticulture; Seed systems; Forestry; and Mountain agriculture. Among the policy issues, the need for greater investments in agriculture (including agricultural research, education and extension) was the most important followed by marketing of agricultural commodities and developing suitable agricultural development policies. Conservation of biodiversity and climate and desertification were considered the two important issues under Environment protection issues. Among the socioeconomic issues, attention to gender/women-related issues and livelihoods analysis were considered the two most important.

Priority areas for investments also include fisheries and aquatic production systems, crop diversification, reducing adverse effects of land and water degradation, improving legal frameworks, and extension and knowledge transfer.

The present state of activities, weaknesses and action required in addressing the priority areas identified have been summarized in the CAC Regional Research Review Report as follows:

- Assure greater investments in and support to agricultural research, education and extension.
- Restructure and strengthen agricultural research, education and extension systems (NARES) (creating suitable structure and capacity building) and ensure the required collaboration, partnerships and linkages among different stakeholders of the AR4D at the national, regional and global levels, which are vital for the region.
- Ensure that the prioritized researchable issues are addressed by the NARS of the CAC countries.
- Develop favourable policies (creating employment opportunities in rural and mountainous areas, marketing of agricultural commodities, and land tenure and property rights) to create a favourable policy environment in different countries of the region and bridge the “underinvestment gap” by investing more in the rural sector and mountainous areas to speed up the development of rural and mountainous areas to improve the livelihoods of the poor.
- Address socioeconomic issues especially gender/women-related issues.
- Given that the CAC region has economies in transition, the countries require a lot of assistance in strengthening agricultural research, education and extension for agricultural development from the international community including the CGIAR and GFAR.

In the priority areas of AR4D in the region the NARES of CAC countries must identify appropriate agricultural development pathways specific to the countries in the region. This will require an analysis of existing models, as well as the need to design and test new models. This will also require policy reforms, and changes in regulatory regimes, increases in institutional investments and better linkages with the private sector. It will require increased capacity development in strategic areas of knowledge and information technology (Beniwal, 2009).

The European Forum on Agricultural Research for Development (EFARD)

Founded in 1997 in Montpellier to participate in the activities of the Global Forum on Agricultural Research (GFAR), EFARD is an informal and volunteer mechanism without its own financial resources; all activities are supported through specific initiatives. EFARD offers a platform for strategic dialogue among the various European ARD stakeholders to promote research partnerships linking Europe and the South. European ARD stakeholders which are part of EFARD include: universities and research institutions represented in particular by NATURA and ECART, which recently joined forces to form

AGRINATURA¹¹; private sector; nongovernmental and producers organizations; donors represented by EIARD.

EFARD's mission follows the principles of the Global Forum on Agricultural Research (GFAR), and contributes to GFAR's Global Plan of Action, in partnership with the other regional fora of GFAR. In particular, EFARD has an important advocacy role to maintain Agricultural Research for Development as a high priority in the political agendas at European and International levels. EFARD contributed to the development of some key ARD initiatives during the last years, for example, the Agricultural Research for Development Dimension of the European Research Area (ERA-ARD) project.

EFARD's geographical region comprises 42 countries, with 18 countries from Western Europe and 1 country associated with the EU programme for research (Israel); and 23 countries from Eastern & South-East Europe. In Europe, there is a diversity of development and agricultural issues facing rural farmers. Levels of absolute poverty are low in comparison with the developing world but relative poverty levels are high, and increasing (EIARD, 2003).

Europe (as a whole) is the largest contributor to the CGIAR. Within this European contribution, the EC has committed more than €110 million since 2007, through the Food Security Thematic Program, to support policy development, sustaining biodiversity, improving germplasm, sustainable management of natural resources, agricultural diversification and climate change and this is supplemented by substantial contributions from member states. Through EIARD the EC is also promoting reform of the CGIAR to further improve effectiveness and accountability. Several CGIAR centers (e.g. ICRISAT, CIMMYT) are situated in emerging economy countries but their reach extends to less developed countries, providing a good mechanism for creating partnerships to deliver ARD results to beneficiaries. Individual European countries have a long history of providing support to developing countries in their efforts to build strong and well functioning NARS, National Agricultural Research Institutions (NARIs) and extension systems that can deliver research outputs to the end-users. In recent years, European governments and the EC have promoted and supported the development of many of the new research approaches and mechanisms, such as regional and sub-regional research organisations, public-private research partnerships, GPPs and CPs (Richards and Chartier, 2009a).

A number of European networks and organisations have been established to facilitate the coordination of European technical contributions to ARD. National ARD fora have been established in most European countries to bring together the broad range of ARD stakeholders from the public, private and civil sectors. These national fora are coordinated by the European Forum for ARD (EFARD), which meets every three years, and acts as the European regional forum of the GFAR. The European Consortium for Agricultural Research in the Tropics (ECART), and the Network of European Agricultural (Tropically and Sub-tropically Oriented) Universities and Scientific Complexes Related with Agricultural Development (NATURA) provide further networking of researchers; and the International Centre for development-oriented Research in Agriculture (ICRA) is dedicated to capacity building in ARD. A European ARD database, and information management services, are provided by EARD-InfoSys+. ¹² Effective promotion and support for these various European ARD activities, and for ARD generally, requires coordination of European ARD policy, which is the role of EIARD. The ERA-ARD project is more focused on coordination issues (Richards and Chartier, 2009a).

There are also differences in the socio-political systems, agricultural policy, agricultural performance, research systems, and levels of poverty which impact on AR4D. EFARD'S challenges are further compounded by weak agricultural R&D processes especially with regard to 'how' research is

¹¹ For further information NATURA, please visit <http://www.natura-net.eu>; for further information on ECART, please visit www.ecart-eeig.org; for further information on their new initiative, AGRINATURA, please visit www.agrinatura.eu.

¹² See www.infosysplus.org for further information.

programmed and implemented by European countries for ARD, and due to a clear lack of coordination between donors – despite the presence of several informal and formal initiatives aimed at facilitating greater collaboration. Knowledge management is also acknowledged to be very weak, under-resourced and generally not fit for purpose. Knowledge transfer problems are acknowledged to exist at all levels – and the need to boost expenditures and change the approaches for knowledge management/extension service systems are proposed by all reviewers.

There are technological as well as social issues which must be addressed to tackle challenges facing poor farmers. Some of these are somewhat different in their particularities in Western Europe from those in Eastern Europe. In Western Europe emphasis will be on the need for efficiency gains in the light of escalating input costs, and reduced sale price of farm produce. High on the Western European AR4D agenda is the issue of specialization vs. mixed enterprises on small farms in light of greater demands by consumer groups, and the need for realistic alternative roles for the future of small farms, given the options of – agro-tourism, carbon trading, commodity specialization etc. Looming large on the horizon is also the need for strategies for coping with and mitigating the effects of climate change at the small farm level.

In Eastern Europe on the other hand the emphasis is on research priorities for small semi-subsistence farmers to enable them to decide whether to intensify their farming enterprises, to diversify their income, to 'hobby farm' or to exit farming. There is considerable effort in innovative approaches to non-farm employment, and some effort at developing organic agriculture/agro-processing/labor intensive industries/part-time activities in addressing the needs of poor producers (Reardon et al., 2009).

The Global Forum on Agricultural Research

The Global Forum on Agricultural Research (GFAR) is a multi-stakeholder-led initiative that serves as an open and inclusive forum for dialogue and action on strategic issues in agricultural research for development.

GFAR's origins lie in a 1994 international consultation on a national agricultural research system vision of agricultural research, which recognized the need on the part of the various stakeholders of agricultural research to develop mechanisms to facilitate understanding of different views, explore research partnerships and exchange knowledge.

From this, the initiative for developing a global forum was supported by the World Bank, FAO, IFAD the EC and other donors for agricultural research. GFAR was established in 1998 to bring together all those involved in shaping and determining the future of agriculture.

The formation of a global forum was a response to the need to:

- Facilitate the participation of all stakeholders in a truly global framework for development-oriented agricultural research;
- Promote the integration and capacity development of national agricultural research systems driven by development demand;
- Increase awareness among policymakers of the need for investment in agricultural research towards development impact;
- Foster collaborative partnerships and the exchange of knowledge among diverse stakeholders in agricultural research for development.

Support through a number of international institutions and wide consultations among stakeholders led to associated actions in the establishment or strengthening of Regional/Subregional Fora. Concurrently CGIAR's funding agencies recognized the need for the CGIAR to expand partnerships through a novel neutral platform.

GFAR mobilizes partners from science and society to reform and strengthen research and extension systems around the world, to increase their impact in development. Sectors represented in GFAR include UN Agencies, the CGIAR, national and regional agricultural research and extension systems, development funding agencies and organizations representing farmers, the private sector and civil society. Its actions are governed by a multi-stakeholder Steering Committee and GFAR operates to key principles of: Subsidiarity (see Box 5), Additionality (value-added products), Complementarity to existing efforts, Openness and Transparency and Inclusivity of diverse partners.

Box 5. Subsidiarity

Subsidiarity is an organizing principle stating that governance ought to reside at the lowest feasible level (i.e. at the local or regional level, instead of the national or supranational level, unless the latter presents clear advantages); thus, the central authority should perform only those tasks which cannot be performed effectively at a more immediate or local level.

If appropriately equipped, GCARD provides GFAR the most important opportunity since its establishment to contribute in the substantive areas of research and technology content for the poor while foster partnerships to make a quantum jump in impacts.

7. OECD Countries Involvement in AR4D efforts

Most OECD countries are active participants in AR4D activities, either directly through their research centers and universities, or as donors in their development assistance programs. Within this group,

Europe

Europe (both Member States and the EU) is collectively the largest actor in the AR4D global system. In 2006 there were 85 programs involving around 1800 organizations working in ARD activities in Europe, with a total budget of 415 million Euros (Africa 44% of total budget, Asia 31%, and Latin America 25%). Efforts were targeted at both research and capacity building (about half each), with around 50% of the budget invested in European research institutions, around 25% allocated to international research institutes and the remaining 25% allocated directly to developing countries – mostly NARS.

The EC also supports ARD through development assistance programs and through the 7th RTD Framework Program (FP7). At the EU level, the international S&T cooperation of the European Union (INCO) has a 20-year history of promoting excellence in scientific and technological cooperation with third countries in all parts of the world. The program is based on dialogue with partner regions and promotes the development of long-term durable research partnerships and uptake of their research results. It increases coordination with Member State's bilateral cooperation and supports the implementation of Community policies with respect to third countries and other international commitments. Its overarching objective is to help stimulate sustainable socio-economic development and global competitiveness by: enhancing the added value and cost effectiveness that joint research projects can generate by exploiting the resources and scientific excellence of all partners, funding new research that reflect EU and partner priorities, exchanging know-how and transfer technologies whenever possible, and providing on-the-job training and work experience. Apart from the EC programs and the bilateral agricultural research programs of several European countries (particularly Germany, France, the UK and Spain) which for practical reasons are not reviewed here, research

funds are also provided to other organizations and initiatives, including the CGIAR system (more than 140 million Euros per year), specific NARS, other national and regional IARCs and regional and sub-regional research networks such as FARA and sub-regional groups.

Two significant changes in the last 10 years period have been the increase in untied bilateral aid from 68 to 92%, and the increased involvement of the new Member States of Eastern as active donors to AR4D activities in different parts of the development world. One of the weaknesses of these efforts, though, is that these large investments tend not to be coordinated at the central level in Europe nor at the developing country level. ARD program planning and funding in EU countries is often shared between different ministries, public institutions, public/private initiatives and research foundations; in recognition of this, in recent times there are number of initiatives aimed at reducing the fragmentation of European ARD by improving coordination between member states.

The Australian Centre for International Agricultural Research (ACIAR)

ACIAR is also a significant actor in the AR4D field. Although it does not conduct research in the developing countries itself, it does develop international agricultural research partnerships that focus on reducing poverty, improving food security, and sustaining natural resource management. ACIAR supports over 300 bilateral projects in developing countries, primarily in the Asia-Pacific region aiming to promote capacity building and knowledge and technology exchange. In 2007, ACIAR's budget totaled 60 million Australian dollars (about US\$50 million), 75% of which was disbursed as grants to partnering research agencies, including the CGIAR centers (ACIAR, 2009).

The Japanese International Research Center for Agricultural Sciences

JIRCAS conducts experimental research for the technological advancement of agriculture, forestry, fisheries, and related industries. Although JIRCAS's mandate includes all developing countries, most of its research is conducted in Asia. In 2007, JIRCAS employed 107 scientists, and its budget was 3.5 billion yen, or close to US\$30 million (JIRCAS, 2006).

Canada

Increasing food security is one of the thematic priorities for the Government of Canada's international assistance envelope (IAE) and one of three priorities for CIDA. Canada stated its commitment in 2009 at the G8 l'Aquila Summit to increase its investment in food security and agricultural development programming by \$600 million over the next 3 years. CIDA's commitment and IDRC's mission and objectives of initiating, encouraging, supporting and conducting research into the problems of the developing regions have now been aligned to create a joint program, the Canadian International Food Security Research Fund (CIFSRF). CIFSRF will have dedicated funding of up to \$CAD 62 Million over a 5-year period and will promote more productive and sustainable agricultural systems through partnerships between research organizations in Canada and in developing countries.

The various components of Agricultural Research for Development (AR4D) in Canada are carried out by a range of actors which include universities, government research centers, civil-society organizations, and private sector companies. The CIFSRF provides the funding support for collaboration on concrete solutions to food security, linking policies, with scientific knowledge, and development activities to combat poverty and improve livelihoods. The CIFSRF funds are to be invested in harnessing Canadian expertise and knowledge for applied research designed to increase crop and livestock productivity and enhance human nutrition.

The CIFSRF is designed to benefit the most vulnerable, particularly women small farmers, and to fund organizations and institutions that can make a difference in sustainable agricultural development. It is expected that the Research Fund will result in the following outcomes:

- Developing country institutions and organizations are better able to implement and support effective, cutting-edge solutions for agricultural productivity and nutrition.
- Canadian-developing country researchers establish and improve upon partnerships that facilitate applied research on food security issues in the developing world.
- Poor people living in rural areas, researchers, and resource managers, are more aware of new and effective technologies that increase sustainable agricultural productivity and the nutritional value of crops and livestock in developing countries.
- Policy makers have greater awareness and understanding of application-ready solutions to food security issues in developing countries

Examples of concrete results of the funded research may include: new knowledge, skills, technologies, innovations, tools, improvements to existing practices related to agricultural productivity and nutrition. Research will focus on topics that include, among others: post-harvest losses, genetic potential of crops, livestock vaccines, crop resilience, the nutritional value of crops and infectious diseases related to crop and animal production.

France and the Centre International de Recherches Agricoles pour le Développement (CIRAD)

French research institutions have a long tradition of investment in research for development bilaterally and in collaboration with the CGIAR. CIRAD and IRD in particular have been implementing a number of collaborative projects bilaterally through their own research agreements with NARS, SROs and ROs but also contributing to the CGIAR research agenda mainly through secondment of scientists to/and implementation of joint projects with IARCs (there are currently about 50 scientists out-posted from both institutions to CGIAR centers, representing an in kind contribution of about 6 Million Euros). Unlike Britain which has lost much of its expertise in tropical agriculture (Royal Society, 2009), France has retained it by substantial involvement of its scientists in international agriculture through the use of its aid funds.

CIRAD's thematic domain of intervention is similar and complementary to the mandate of CGIAR. CIRAD has a budget of 203 million euros (2008) and 1,800 staff including 800 researchers. It works with more than 90 countries, and has regional scientific platforms in the French overseas regions. It hosts and trains around 800 researchers and technicians every year. One of CIRAD's objectives is to promote the development of a more balanced global system involving CGIAR centres, advanced research institutions (ARI), universities, and research centres of developing countries. France and CIRAD are supporting the Global Forum on Agricultural Research (GFAR), which has been mandated by the international community to fulfil this task.

Partnership is a founding principle mentioned in the statutes of CIRAD (1984) which set out CIRAD's mandate within French national agricultural research and in implementing its international activities. In 2009 it had 200 researchers posted abroad in national, regional and international institutions which amounts half of all CIRAD researchers, who are collaborating directly with partners at their home sites.

CIRAD has its most numerous and long-standing ties with Sub-Saharan Africa which remains a geographical priority. But has also signed many scientific agreements over the years and set up major research programmes with organizations on other continents. CIRAD interventions in developing

countries are supported by research carried out in Montpellier and in the French overseas department and territories.

The United States of America

The Agricultural Research Service (ARS) of the United States Department of Agriculture (USDA) is the principal in-house research agency of the department, and one of the three mission areas (the other two being Education and Economics). This program now has a work force of approximately 8,000 employees including 2,000 scientists representing a wide range of disciplines. The agency's mission is to develop end transfer solutions to agricultural problems of high priority and provide information access and dissemination to ensure high quality, safe food and other agricultural products, assess nutritional needs of Americans; sustain a competitive agricultural economy, enhance the natural resource base and the environment, and provide economic opportunities for total citizens, communities and society as a whole. The office of International Research Programs (OIRP) serves as the principal contact for international activities in the ARS. The OIRP mission is to enhance the productivity, effectiveness and impact of the ARS national programs through mutually beneficial international activities to facilitate international cooperation and exchange to benefit US agriculture and the consumer; to participate in activities that promote the strategic interest of the US Government, and to extend the capacity of the US national programs to address problems confronting US and global agriculture.

The following are among the many issues and constraints that extend beyond the borders of the US which require collaboration from the ARS' regulatory and action agencies:

- the ability of developing countries to feed themselves
- the threat of foreign diseases to crops and livestock
- the need to ensure that U.S. crops don't harbor diseases or pests that might restrict their trade
- a responsibility to lead in developing scientific and intellectual capacity worldwide.

These challenges have taken on greater emphasis at USDA and ARS. So, globalization of selected strategic areas of work is a natural evolution of the agency's national programs. Food safety is now one of several of ARS' major programs that have global implications, to ensure that trade partners establish and adhere to certain quality standards. There is also major emphasis on germplasm collection and enhancement, as the genetic base of many crops shrinks and wild species are displaced by a burgeoning human population, the need increases to locate and exchange genetic resources around the globe. Feeding the rapidly increasing global population will depend increasingly on genomics and genetic improvement.

Other areas of collaboration with international partners now include access and knowledge of mechanized farming as the need for large-scale agricultural production increases; and increasing attention is being paid to environmental protection, especially high air, soil and water quality standards.

USDA/ARS has had a long-standing research program with Israel under the Binational Agricultural Research and Development fund (BARD). Since its inception in 1977, BARD has financially supported more than 850 research projects of mutual benefit to both countries. Its germplasm system contributes to the global resources towards solving food insecurity in parts of Africa, and its biotechnology skills are being used to support a more productive agricultural sector in many parts of the developing world. Under a memorandum of understanding with the Consultative Group on International Agricultural Research (CGIAR), ARS is partnering with CGIAR-member centers

throughout the world to develop stress-tolerant germplasm through innovative biotechnological approaches. USDA 's search for new agricultural products is contributing to the viability of farm enterprises, creating cures for diseases, uncover unique phytonutrients, and introducing entirely new views on what constitutes good nutrition.

There is some recent development in research on bio-based energy to produce new fuels that are both more efficient and environmentally benign. Superimposed on all of this is the need to promote science education and capacity. The United States, through the work of ARS is playing a global role in promoting science and technology, through training a new generation of researchers to meet the needs of the new millennium. Joint programs have been developed with: Latin American countries to advance research in graduate education through the Tropical Agricultural Research and Higher Education Center (CATIE) and various U.S.-based universities; with ministries of agriculture in Africa to ensure advanced training of scientists who will work towards food security for the peoples of Africa.

The National Institute for Food and Agriculture (NIFA). Recognizing the increasingly global nature of agriculture, the U.S. Department of Agriculture's (USDA) National Institute of Food and Agriculture (NIFA) (formerly the Cooperative State Research, Education and Extension Service (CSREES)) has planned and implemented a number of technical assistance projects in developing countries. Since the 1980's, the agency's International Programs (IP) office has collaborated with land-grant universities and other institutions to provide expertise around the world. Although NIFA does not have funds of its own to carry out foreign assistance programs, it has obtained funding from such sources as the State Department, the U.S. Agency for International Development and the Foreign Agricultural Service (FAS) to reimburse U.S. universities for engaging their faculty. In addition to the projects outlined below, NIFA may also recruit university faculty for short-term agricultural development assignments overseas identified by FAS. The intent of these projects is not only to provide appropriate technical assistance abroad, but to also strengthen the international dimension of research, education and extension programs at our partner institutions here at home.

U.S. Land Grant Universities. Drawing on the agriculture extension knowledge and resources available at the land-grant universities, NIFA provides agriculture research, education and extension training through collaboration with several US universities which include: Texas A&M University, New Mexico State University, University of California-Davis, Utah State University and Washington State University, Michigan State University, Ohio State University, The University of Wisconsin, and Cornell University.

The United States Agency for International Development (USAID). USAID works to bring the latest scientific knowledge and technology to those who need it most and helps farmers innovate and adapt to overcome agricultural development challenges. USAID assists partner countries and regions to formulate science policies, strategies and governance systems; support technology development and application; expand public and private sector partnerships, institutional capacity-strengthening to stimulate greater production and processing of foods, and promote more efficient delivery of products to end users (USAID, 2010).

USAID's strategy to promote the link between agricultural producers to markets includes:

- **supporting development of sound policy environments** that enable open markets, private sector investment, and gender-equitable access to factors of production, products, and income

- **promoting effective institutions and services**, such as rural extension and finance, to enable both women and men producers to acquire, protect, and use the assets they need to take advantage of emerging market and trade opportunities
- **strengthening producer and other rural organizations** to help them participate effectively in markets, reduce transaction costs, acquire productivity-enhancing technologies, and make use of information on domestic, regional, and international markets
- **developing product standards and quality control** to meet market demands for food safety, purity and quality, and to reach higher-value markets
- **identifying infrastructure development priorities** to support efficient marketing and reduce high transport and storage costs that undercut the advantage of low production costs
- **building food system value chains** that connect small-holder agricultural producers to national, regional and global markets
- **developing the public sector's roles** as provider of market-facilitating goods and services, regulator and referee, and monitor and analyst.

Examples of USAID's work and partnerships:

Agribusiness Market and Support Activity (AMARTA)

A three year, \$14.9 million project from 2006 to 2009 to assist the Government of Indonesia to promote a robust Indonesian agribusiness system that will significantly improve employment, growth, and prosperity.

Kenya Horticulture Development Program (KHDP)

A project that works to increase and sustain smallholder sales and incomes in Kenya from the production and marketing of high-value and added-value horticultural crops and products, and to increase incomes from employment within the wider horticultural industry.

Partnership for Food Industry Development – Fruits & Vegetables Program

A joint university and food industry technical assistance program that collaborates with public and private partners to increase the competitiveness of small and medium scale producers in local, regional, and international markets. Projects are in operation in Guatemala, Nicaragua, India, South Africa, and Ghana.

Partnership for Food Industry Development – Meats, Seafood & Poultry Program

A university based partnership that promotes awareness of food safety, food security and international regulatory compliance, enhancing the international market enhancement and improving food safety for consumers. The Partnership works in the former Soviet Republics, Nicaragua, and South Africa.

Partnership for Food Industry Development – Natural Products Program

A public-private partnership that works toward sustainable improvements to the livelihoods of rural producers in Sub-Saharan African communities through the development of the natural products and natural foods markets.

The USAID primarily supports science and technology through the Collaborative Research Support Programs (CRSPs) and the Consultative Group on International Agricultural Research (CGIAR). Since 1975, USAID has funded long-term multidisciplinary research and training initiatives through collaboration between researchers from US universities and scientists from developing-country universities, national agricultural research systems, the CGIAR, US agricultural companies, and NGOs to identify research needs, design research projects, analyze results, and disseminate knowledge. Other agriculture-related science and technology programs supported by USAID include the

following: Agricultural Biotechnology Support Program II - supporting scientists, regulators, extension workers, farmers, and the general public in developing countries to make informed decisions about agricultural biotechnology; Farmer-to-farmer Program ; International Fertilizer Development Center (IFDC); Middle East Regional Cooperation (NERC) Program; and the US-Israel Cooperative Development Research (CDR) Program.

Recognizing the important role women play in development, USAID and its partners also support women's capacity to participate in innovation and ensure that investments in science and technology are regionally and nationally appropriate.

B. Financial and Human Resources Support for AR4D¹³

1. Developing regions are gaining ground within a context of slower global growth and immense change in the diversity and capacities

While developed countries still represent the greatest share of total public agricultural R&D expenditures, the share of developing countries (excluding those located in Eastern Europe and the former Soviet Union) has increased from 38 percent in 1981 to 44 percent in 2000 (see Table 2 and Figure 27). Worldwide, public investment in agricultural R&D increased by 50 percent in inflation-adjusted terms between 1981 and 2000 from an estimated \$16 billion to \$24 billion (in 2005 PPP dollars).¹⁴ Although public agricultural research grew faster in less-developed countries, the developing world still invests substantially less of the world's total (i.e., public and private) agricultural R&D spending. The Asia and Pacific region has continued to gain ground, accounting for an ever-larger share of the developing country total. Since 1981, while Africa has remained largely stagnant, the growth rate of expenditures across the globe (developing and high income countries), has decreased from 2.7 % in the 1980s to 1.2% in the 1990s. This reflects a trend towards a contraction, or possible slowing, for support for public agricultural R&D among developed countries. In part, this points to a shifting emphasis from public to privately performed agricultural R&D when it comes to production issues, but also to a shift in government spending priorities. This overall picture can be characterized as positive. Yet it hides, besides the implications of a slower rate of growths and the long terms implications of the lessened support to agricultural research in the developed world, to a number of other issues of concern.

¹³ The GAT is especially grateful to Nienke Beitema for her help with updating human resources and financial data in this report.

¹⁴ Expenditures in this chapter are expressed in purchasing power parity (PPP) prices. The purchasing power of a currency is expressed using a basket of goods and services that can be bought with a given amount in the home country. International comparison of, e.g., Gross Domestic Products of countries can be based on the purchasing power of currencies rather than on current exchange rates. PPP estimates tend to lower per capita GDPs in industrialized countries and raise per capita GDPs in developing countries (Metz et al., 2007).

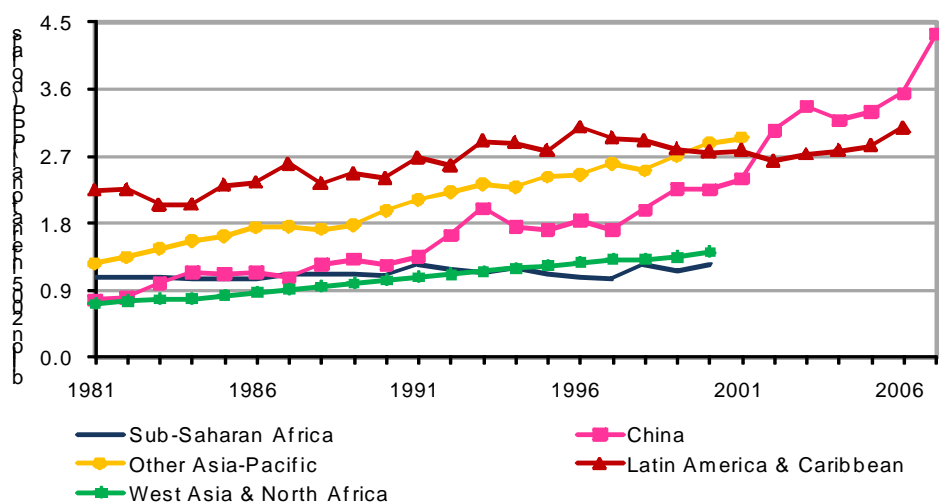
Table 2. Total public research expenditures by region, 1981, 1991, 2000

Region/country	Agricultural R&D Spending (million 2005 international dollars)			Share of global total (percent)		
	1981	1991	2000	1981	1991	2000
	<i>Developing countries</i>					
Asia & Pacific (26)	2,032	3,460	5,120	12.7	16.3	21.4
China	773	1,350	2,250	4.8	6.3	9.4
India	400	748	1,301	2.5	3.5	5.4
Latin America and Caribbean (25)	2,245	2,676	2,755	14.0	12.6	11.5
Brazil	979	1,414	1,247	6.1	6.6	5.2
Sub-Saharan Africa (45)	1,084	1,253	1,239	6.8	5.9	5.2
West Asia and North Africa (12)	720	1,074	1,412	4.5	5.0	5.9
Developing-country subtotal (108)	6,081	8,463	10,525	37.9	39.8	43.9
<i>High-income countries</i>						
Japan	2,073	2,469	2,517	12.9	11.6	10.5
USA	2,896	3,678	4,377	18.1	17.3	18.3
High-income country subtotal (40)	9,951	12,806	13,456	62.1	60.2	56.1
Total (148)	16,032	21,268	23,981	100.0	100.0	100.0

Source: ASTI datasets and other secondary data sources as presented in Beintema and Stads (2008b and 2010)

Note: The number of countries included in the regional totals are shown in parentheses. These estimates exclude low and middle-income countries in Eastern Europe and the former Soviet Union. Estimation procedures and methodology are described in Pardey et al., 2006b, Beintema and Stads, 2008b, and various ASTI regional reports available at asti.cgiar.org.

Figure 27. Public Agricultural R&D investment trends in Developing Countries, 1981 - 2006



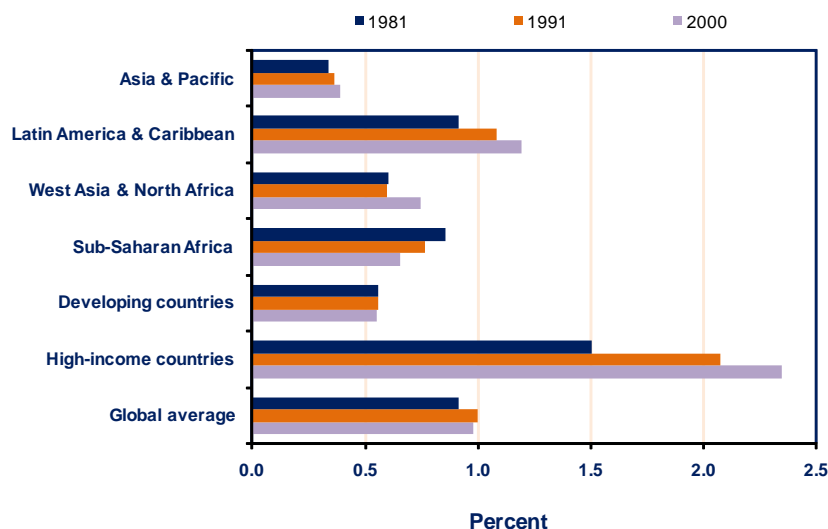
Source: ASTI datasets as presented in Beintema and Stads (2008b and 2010)

2. A global context of evident underinvestment

Research intensity ratios (measured as agricultural research investment relative to agricultural GDP) have been considered a good indicator of the level of the political priority allocated to AR4D and of the extent of the underinvestment problem affecting the developing world AR4D system (Figure 28). The average agricultural research intensity in developing countries was 0.58 in 2000, that is \$0.58 per \$100 the domestic agricultural product of the developing countries taken together, a figure similar to what they were investing twenty years earlier in 1981. Latin America and the Caribbean and the Asia-Pacific regions showed moderate increases in their rates through this period and again Africa showed a deterioration of an already modest rate.

This situation is in sharp contrast to the trends in the developed world where the intensity ratio was 2.4 in 2000, a slight increase from the 2.1 levels developed countries were showing a decade earlier. The consequence of this trend is a growing divide between the different parts of the world about their abilities to confront the challenges they face in terms of developing a sound technical basis for poverty reduction and sustainable food security strategies. Some of the impacts have already started to show in the evolution of production and productivity growth in the major food commodities, but the full impact would come in the future when the world will confront food demands of a growing global population and a more hostile climate change environment.

Figure 28. Intensity of Agricultural R&D Investments. Global and different regions of the world. 1981 - 2000



Source: Updated from Beintema and Stads (2008b) and Pardey et al. (2006b) using new ASTI datasets.

3. A high concentration of capacities in just a few countries

Although research expenditures in the developing world have increased at a healthy rate, aggregate figures hide a situation of great disparities among countries, with a small group of countries representing an ever growing share of investments and a large number amounting only to a very small fraction of existing capacities. The last two decades have seen the emergence in the developing world of a number of research giants – with capacities to compete with developed countries in a number of areas – along side with a majority of the smaller countries lacking the minimum scale required for an effective research effort. In 2000, 46% of all public agricultural R&D investments in developing countries were concentrated in just three countries—China, India, and Brazil. This was an increase from their 35% share in 1980. In stark contrast, sub-Saharan Africa continued to lose ground, falling from 18 to 12% of the developing country R&D investment total.

This pattern of concentration parallels what is happening in overall science spending patterns throughout the world. In developed countries, agricultural R&D has also become increasingly concentrated in a handful of countries, with just four countries (the United States, Japan, France, and Germany) accounting for 60% of all public R&D conducted in 2000; a similar share as in 1981. Just five developing countries (China, India, Brazil, Thailand and South Africa) undertook 53% of the developing countries' public agricultural R&D in 2000, up from 42% in 1981 (ASTI revisions based on Pardey et al., 2006b; Beintema and Stads 2008b and 2010). Meanwhile, in 2000, a total of 80 countries with a combined population of approximately 625 million people conducted only 6.3% of total agricultural R&D (Pardey et al., 2006b). Besides research conducted in advanced countries is

less directly of use to developing countries and its gestation lags in achieving impacts have increased (Pardey et al., 2007).

4. A Vast Majority of Public Resources

Who pays the bill is another major issue in which there are great differences between developed and developing countries. In the developing world, the public sector are, by large, the main providers of AR4D funding, accounting for more than 90% of total funds in 2000 (Table 3). There is the absence of significant private involvement, in sharp contrast with in the situation in the developed world, where the private sector represents more than 50% of all resources. This has a number of significant implications both in terms of management restrictions as well as the instability it brings to program implementation and, in many cases, the polarization of programs.

Table 3. Estimated global public and private agricultural R&D investments, circa 2000

Region/country	Expenditures			Share		
	(million 2005 international dollars)			(percentage)		
	Public	Private	Total	Public	Private	Total
Asia & Pacific	5,120	447	5,567	92.0	8.0	100
Latin America & Caribbean	2,755	135	2,890	95.3	4.7	100
Sub-Saharan Africa	1,239	22	1,261	98.2	1.8	100
West Asia & North Africa	1,412	51	1,463	96.5	3.5	100
Subtotal, Developing countries	10,526	655	11,181	94.1	5.9	100
High income countries	13,456	15,470	28,926	46.5	53.5	100
Total	23,981	16,125	40,106	59.8	40.2	100

Source: Updated from Beintema and Stads (2008b) and Pardey et al. (2006b) using new ASTI datasets.

The government sector remains responsible for most of the public agricultural research (defined as government, higher-education, and nonprofit sectors). And government allocations remain the main source of funding for government-based agricultural research. For a sample of close to 400 government agencies in about 55 developing countries, government allocations represented 84% and donor loans and contributions another 7%, with the rest coming from different sources, including sales from products and services, public enterprises and marketing boards (Echeverría and Beintema, 2009). This picture – surprisingly homogenous across developing regions – does vary at the country level. For instance in the Asia and Pacific region some countries have government contributions in the 60-70% range, while in India the government accounts for more than 90%. A similar trend is present in LAC, with countries such as Argentina, Panama and El Salvador reporting government shares of over 90%. In contrast, a relatively large number of countries show a very high level of donor dependency, with government allocations below 50% of total resources (Echeverría and Beintema, 2009).

5. The Unbalanced Human Resources Situation

Human resources availability and training is also an area of differing tendencies. Since the early 1970s, most developing countries have made considerable progress in building their research staff capacity, both in terms of total researcher numbers and qualification levels (that is, postgraduate degrees). By 2000 there were between 150,000 to 2000,000 full time researchers in the developing world and in most countries – with the sole exception of China – showing positive growth rates for most of the period, but the main feature of the process was not so much the increases in the numbers of researchers, but the significant increase in the proportions of researchers holding postgraduate degrees (MSc or PhD), with all the developing regions showing average figures of the percentages of highly trained personal in the 20-30% range and some individual countries, such as

India, Bangladesh, Pakistan, Brazil, and Mexico reporting the highly trained personnel representing proportions greater than 80% of the total number of their research staff. The participation of female scientists has also increased in some countries (see Box 6).

Box 6. Female Scientists and Researchers in Agricultural R&D

“Over the past few decades, the number of female scientists and managers working in agricultural research has increased significantly in both industrialized and developing countries, although empirical studies have repeatedly shown a disproportionately low number of women working in senior scientific positions. In addition, the attrition rate of female researchers in S&T agencies is higher than that of their male colleagues. Throughout the world, female scientists are subjected to more stereotyping and associated negative biases in the work place than their male colleagues; they are less well connected to informal social and professional networks, ultimately leading to lower publication rates; and the cultural stereotypes of men’s and women’s roles within the household still appear to limit women’s opportunities for advancement into senior positions. For this reason, the integration of women into research agencies, which have traditionally been staffed largely by men, poses challenges for women interested in building a career in the sciences, as well as for employers responding to demographic shifts” (Stads and Beintema, 2006: 1).

According to the ASTI regional surveys, in Asia and the Pacific Region, the 11-country sample for 2002/03, one in every five agricultural researchers was female, but this average masks large variations across countries (for instance, Pakistan 6% and Philippines, at 40%). Similarly, in LAC a 15-country sample for 2006, shows 34 percent of all agricultural researchers were female, but this average masks large variations across countries (Argentina and Uruguay more than 40% while Honduras, Guatemala, El Salvador and Panamá the average is less than 20%). In 2000, 18 percent of African agricultural researchers in the 27-country sample were female but in this case, the distribution is more homogeneous (Beintema, 2006).

In Asia and the Pacific and LAC, female scientists are also consistently less well-qualified than their male counterparts. For example, in Asia and the Pacific, fewer women than men held PhD degrees on average (29% compared with 41%) while in LAC the difference was smaller (60% compared with 67%).

The number and increased quality of scientists cannot be taken, however, as a direct, or only, measure of the systems’ increased operational capacity. Even though, as indicated above, agricultural research expenditures have grown at a healthy rate in many parts of the developing world, in some they have not kept pace with what has happened with the number scientist, creating a sharp decline in the levels of spending per scientist throughout the developing world, in a marked contrast with what happened, for instance, in the US, where resources available per scientists grew by more than 50% between 1981 and 2000, at a rate of 2.6% per year. This is the case in Sub-Saharan Africa (27 country sample) expenditures per scientist in 2000 were only 70% of what they were in 1980, and in Latin America and the Caribbean (11 countries sample) where the reduction was less pronounced, but noticeable and significant nevertheless (Pardey et al., 2006b). In Asia the situation is quite different, as the available resources per scientist grew by 30% between 1991 and 2002, if China was not considered (11 country sample) and by 90% in China was included in the calculations (own calculations on the basis of information in Beintema and Stads, 2008a).

6. Research efforts concentrated in crops

About half of all the agricultural research effort in the developing world is directed to crop improvement (53.3% in Asia and the Pacific, 45.5% in South Saharan Africa, and 43.3% in Latin America and the Caribbean). Of the remaining 50%, 15-20% goes to livestock, 7-13% to natural resources related research, and 4-8 % to forestry and forestry issues. Post harvest related research accounts for less than 5% in every region, and socioeconomic research receives equal or less attention. Within the crops fruits and vegetables are the most important emphasis as crop group amounting to between 20% and a quarter of all the research effort and rice, wheat and beans are the more important as individual crops. As could be expected, the country by country differences in

research efforts are considerable (Echeverria and Beintema, 2009).

C. Conclusions and Implications for the future

- There is a large diversity of actors involved in the AR4D global system. The original system consisting of a relatively simple set of national agricultural research institutions has significantly grown to include universities, various types of regional and sub regional organizations, networks – institutional, disciplinary, crops – farmers and commodities organizations, civil society organizations of different types, international research organizations, private sector entities and specialized centers from industrialized countries, among others. This diversity covers a vast spectrum of agro ecologies and levels and provides an invaluable platform for future development.
- Behind the diversity of actors there are also important differences: majority of very small and understaffed national systems and at the same time the emergence among some developing countries of a small number of research power-houses that open up a great number of new opportunities for innovative partnerships and south–south cooperation.
- For effective AR4D public and private actors need to act together. Private R&D fosters innovation and productivity gains in agriculture in both rich and poor countries. The role of the private sector in agricultural research in the developing world has evolved rapidly from its initial involvement with a few export crops in the post world war period to become a key player in the supply of genetic technologies and seeds, agrochemicals, veterinary products, agricultural machinery and implements. A key issue in private sector participation in developing countries agricultural research is that of public-private partnerships (PPPs). These are aimed at joining effort to exploit better each partner’s areas of strengths. This type of mechanism are increasingly becoming effective means of conducting advanced research, commercializing new technologies, and deploying new products for the benefit of small scale resource-poor farmers, food insecure consumers and other marginalized groups in developing countries.
- In recent decades there has been a significant increase in different types of international agricultural research associations at different levels and in new networks. Among other advantages, they aim to complement national agricultural research infrastructures and help capture technology spillovers across geographical and national boundaries, and in the case of the small countries can become significant resources towards lifting some of the diseconomies of scale limitations they confront. These types of institutional mechanisms are present in all regions and they represent a major actor in the current AR4D landscape and for any future improvement strategy.
- Within this context the CGIAR plays a significant role as a key partner with contributions that probably go well beyond the small percentage of the global system it represents, particularly in their contribution to the “green revolution” and increased food security in the past. Its current attempt to realign its strategy to increased effectiveness in transforming research output into development outcomes and be more effective in their contributions to poverty reduction and environmental services is a positive process and so far has shown congruence with priorities and expectations as expressed from the different regions. However, to be fully successful and effective it will need to assure adequate levels of consultation with the other stakeholders in the design of its operational details.
- OECD countries are also key actors in the AR4D effort not only as donors supporting a great variety of programs and specific projects and activities through out the world, but also as sources

of relevant scientific knowledge and human resources capacity building. These efforts, however, are undertaken without any coordination, and, in many cases, are overlapping. Improved dialogue and coordination, as is been tried in SSA in recent years, could lead to a significant increase in resource use efficiency and greater impact.

- This evolution is reflected in AR4D investments which have grown significantly over the last decades outpacing the growth rate of expenditures of the developed countries, clearly indicating that, at least in some countries, the potential of research as a key input for development objectives is receiving higher political attention and priority than before. This is clearly the case of the countries in the BRICs group and some other of the more advanced developing countries. Countries with the largest share of population and GDP in agriculture has the lowest share of GDP invested in agriculture, whereas industrialized countries with a small share of population and GDP in agriculture investment a far higher share of GDP in agriculture, research and their investments have continued to grow. The result is a far greater differentiation among NARS capacities and major implications for future investments in agricultural research.
- There is also clear evidence of substantial and pervasive underinvestment. Research intensity rates are well below those of the developed countries, in contradiction between the nature of the challenges the developing countries are confronting and the levels they are investing in those problem areas. Developing countries are much more dependent on agriculture in the fight against hunger and poverty than developed countries, still investments aimed at improving agricultural productivity and food security lag behind what they should be.
- Government funded research accounts for more than 60% of all resources flowing into public-performed agricultural and natural resources research in all regions, with peaks of more than 90% in some countries, mostly in the case of Africa and some of the smaller countries in Central America and also in Asia. Private sector although important in some countries, is still a minor component of investments in the sector, a characteristic that brings great and instability to research systems, particularly in those with weak economies.
- Human resources improved in quantity and quality in almost all the countries and institutions when research expenditures were increasing in developing countries more or less across the board in the 1980s. In large and middle income countries, they have become the base of formidable infrastructure, but even in their case financial resources have not kept pace with this transformation, pointing to an emergent problem in terms of (i) having the people to do the work needed but no resources to actually carry it out, and (ii) due to falling relative salaries, not being able to retain highly trained personnel, with the corresponding waste of efforts and investments. But many, particularly small countries, are also experiencing serious decline in capacities and with aging senior staff and staff departures to non-research posts or abroad - necessitating urgent investments in capacity building are needed to maintain and improve future capacity.
- On balance research undertaken remains traditionally-oriented, focusing on crop improvement, with little evidence that the emergent issues related to the environment and value-adding are been attended. Natural resources and post-harvest research, two indicators of the priority these issues are receiving, are relatively small proportions of continuing efforts.

Chapter 4: “Delivering” Research Outputs: Conditions for Adoption, Co-Creation and Delivery of Knowledge and Technologies among Poor Farmers

In a detailed analysis, “Secret of Gujarat’s Agrarian Miracle after 2000”, Shah (2009) demonstrates that (i) small farmer productivity and incomes can be increased in semi-arid areas ii) the multi sectoral package of policies, institutions and infrastructure needed to achieve productivity growth in a semi arid area, iii) the complex and sophisticated mix of enabling environment which occurs in some parts and not others of India, and iv) collaboration between international and national research and operational institutions (in this case IMWI, IFPRI and the Water Institute of India) can demonstrate what works and why and help generate a national dialogue on improved policies and strategies. More such intersectoral good practices are needed through applied research conducted on a routine basis to better understand ways to improve public policy in developing countries. Developing country policymakers and institutions need to play a leading role of the kind the government of Gujarat is reportedly doing. The purpose of this chapter is to illustrate the enabling “non-technology” factors required to achieve food security and poverty reduction.

Secure Land Rights

Secure predictable access to land is a key to sustainable intensification of production systems. The lack of secure land rights acts as a disincentive for small holders to invest in land improvement among other things by being a hindrance to obtain finance needed for intensification (Godfray et al., 2010).

A combination of factors has led to growing interest in land with agricultural or forest management potential: urbanization, infrastructure development, industrial investments, higher agricultural commodity prices, demand for bio-fuels, focus on various carbon sequestration schemes of Reduced Deforestation and Degradation (REDD). Numerous new investors are interested in large-scale acquisition of land with agricultural and forest management potential making poor farmers and forest dependent communities increasingly vulnerable to displacement by powerful interest groups. Interest in land is also posing governance challenges (World Bank, 2009; RRI, 2010).

In the discussion of payments for environmental services the new climate mitigation programs such as REDD, the Forest Carbon Fund and the Bio carbon Fund, are attracting increasing attention from civil society groups to the potential risks of loss of rights of forest dependent communities.

Where the political will and organizational infrastructure exist, definition and protection of land titles can be greatly accelerated by the application of modern information and communication technologies as in the Punjab. The task of providing adequate legal protection for land use is complicated in many countries by the existence of often overlapping formal and informal systems of land use and the process is intensely complicated.

Many countries such as China, India and Brazil, are devising their own solutions to address issues of agricultural and forest land rights including policy reforms, the use of GIS and information technology for registering lands and incentives in the forms of payments for more sustainable land use. China has undertaken a major forest land reform similar to the one it adopted in the case of agricultural lands and is spending \$50 billion by 2015 in support of payments for environmental services, by far the largest program in the developing world (Lele, 2009; Xu and White, 2004).

At the international level, in response to the growing and widespread interest for an international governance of land tenure instrument that can be adopted and implemented by developing countries, the FAO’s International Land Coalition Secretariat (2010) is engaging civil society and

expert groups in developing voluntary guidelines and practical guidance to states, civil society and the private sector on responsible governance of tenure. By setting out principles and internationally accepted standards for responsible practices, the guidelines will provide a framework and a point of reference that stakeholders can use when developing their own policies and activities in the land sector.

In recognition of the interconnectedness of land acquisition and agro-enterprises, the World Bank has adopted a dual-pronged approach, namely: (i) dialogue with governments to define principles, provide guidance, and assess the magnitude of on-going trends through empirical research, and, (ii) definition of issues, best practices, decision tools, and codes of practice for governments and investors in land-extensive agriculture. The World Bank has also initiated a study to assess country-level frameworks and a documentation of projects proposed or implemented in the last five years (World Bank, 2009).

What the countries need most are transparent land records and a fair system of changing land ownership, access and land use that enables citizens of each country to make informed, equitable and fair decisions.

Land under foreign control remains a relatively small proportion of total land areas in most cases but is increasing. Unlike foreign investments in traditional cash crops, the more recent investments are in food, feed and the more traditional horticultural exports, for example in East Africa, for example - but emphasizing various forms of joint ventures (Hallam, 2009).

Major investors in current investment flows are the Gulf States but also China and Republic of Korea. While the main targets are in Africa there are also investments in Pakistan, Kazakhstan, Cambodia, and Brazil. Private sector, governments and sovereign wealth funds are all involved. Private sector investors often prefer investment or holding companies rather than agro-food specialists which means that the necessary expertise for managing complex large-scale agricultural investments needs to be acquired. More traditional FDI continues but the recent investments involving acquisition of land and actual production are against the trends in FDI more generally. There may be some signs of a shift away from Africa and a search for greater local involvement through joint ventures as with FDI in the past (Hallam, 2009).

Revival of Extension

After a period of neglect and considerable disinvestment, agricultural advisory services are showing welcome signs of returning to the international agricultural and development agenda and donors appear to be more receptive to the idea of supporting public extension (see Box 7). Agricultural advisory (extension) services are a vital element in the whole AR4D process. A range of market and non-market entities and agents provide critical services in support of improving farmers' and other rural people's welfare (Anderson, 2008; World Bank, 2008). Apart from their conventional function of providing or transferring knowledge for increasing productivity, these services are now increasingly being expected to fulfill a number of new functions, such as linking smallholder farmers to high-value and export markets, promoting environmental outcomes (such as watersheds, forests, irrigation water), supporting micro-credit groups, and coping with the effects of HIV/AIDS and other health challenges (Pretty, 2003; World Bank, 2008). Agricultural extension has significant public good attributes. There are an estimated half a billion official extension workers of various types and competencies worldwide, most publicly-funded and most still publicly-employed (Anderson, 2008). Yet there is a widespread perception, highlighted in the regional consultations, that agricultural extension services as they existed in the past have collapsed and small farmers with too small a surplus to sell in the market have little or no access to agricultural extension.

Changing the behavior of farmers through policy mechanisms is a challenging task for policy makers and delivery agents alike because it involves the attitudes, motivations and deepest values of farmers and not just economic rationality and policy coercion (Burton and Wilson, 2006; Hall and Pretty, 2008). In the past, agricultural extension agents emphasized a close working relationship with farmers to ensure changes in the attitude and behavior of individuals and the efficient uptake of grant aid (Röling, 1985). These relationships with farmers were often characterized by mutual trust and respect developed through face-to-face meetings and farmer groups over lengthy periods of time.

The agenda for pro-poor agricultural research has recently been expanded to include increasing production of staple crops; increasing productivity in less favored lands; helping smallholder farmers to diversify into higher-value products, including livestock products; increasing employment and income earning opportunities for landless and near landless workers in labor-surplus regions; and investing in agricultural technology that reduces the price of micro-nutrient rich foods. With such a wide ranging agenda, and where trade-offs are likely to be substantial, it is appropriate to consider alternative policies for poverty alleviation. Under these circumstances, Hazell and Haddad (2001) note that technology is only one instrument for helping the poor, and that indeed it is not always the most effective one. They argue further that its role must be seen within the broader context of rural development and grassroots development efforts (see the preceding section on land).

Given the broader AR4D context and the challenges for innovative delivery, the old model that assumed a linear relationship between research, extension and farmers, with organized publicly funded science as the source of innovation, has proven to be grossly inadequate (Lele and Ekboir, 2004). This approach was essentially a supply-driven and top-down system, promoting agricultural messages that had been designed and developed by research scientists, with limited input from the technology-users themselves (farmers and other rural people). The conceptualization of the nature of agricultural technology development and transfer has advanced considerably in the last two decades, and it is now widely recognized that innovations derive from multiple stakeholders including farmers and CSOs. Innovation pathways, implementation and adaptation need good extensionists as well as good scientists.

Alongside these changes, the revolution in information and communication technologies and information management systems is radically opening out access to external knowledge among even the poorest. The rate of growth of mobile phone technology is particularly striking. In 2009, mobile cellular penetration in developing countries passed the 50% level, reaching an estimated 57 per 100 inhabitants more than doubling the rate of cellular phone penetration from only 23% in 2005, a giddy rate of progress. Together with the spread of internet access, this means in practice, agricultural information can be increasingly sourced from anywhere in the world, often already in a tailored form.

What is missing are the innovation brokers, such as the M.S Swaminathan Research Foundation, who are both accessing external knowledge and developing some of their own, making it relevant and tailored to the needs of the community concerned (Lele, 2010) Such information interfaces with the specific needs of individual and community development requires much research investment to develop "Google for the Poor" which still separates dissemination of knowledge from its generation and under-invests in this area (Lele and Gandhi, 2009).

The new formats of extension operations depart from old public service models with their many deficiencies (such as weak public commitment, severe fiscal challenges, lack of accountability to farmers, lack of proper connections and relations between agricultural scientists and extensionists).

They differ from traditional public service models by promoting institutional innovations and reforms and are often pluralistic. They promote the formation and participation of farmers' organizations, decentralization, partnerships with NGOs (e.g. an approach followed by Uganda's National Agricultural Advisory Services), and engagement with public-private partnerships (e.g. Ghana Grains Partnership).

The appropriateness of the technology that emerges clearly depends on how the agendas of these different stakeholders are addressed. Farmer participation in technology development and participatory extension approaches have emerged as a response to such new thinking. New approaches such as *Farmer Field Schools (FFS)* and the *Agricultural Knowledge and Information System (AKIS)* have been developed that emphasized development of both social and human capital. Direct farm level links between researchers, extensionists and farmers are a pre-requisite for technology innovation and adaptation.

The new approach to extension links farmers more effectively and responsively to domestic and international markets; thus enhancing crop diversification and combining technology transfer with other services relating to input and output markets. This approach also addresses poverty reduction and so ensures that agriculture is considered as part of a wider set of rural development process that includes enterprise development and non-farm employment. It includes capacity development in terms of strengthening innovation process, building linkages between farmers and other agencies, and institutional development to support the bargaining position of farmers (Sulaiman et al., 2006). While this approach has now been in the vogue emerging evidence suggests that it does not reach marginal farmers or women headed households (World Bank and IFPRI, 2010).

Box 7. Summary of the value of interactive agricultural knowledge systems that engage research, extension and farmers

1. The Transfer of Technology (ToT) model has been the most dominant model used in operational arrangements and in policy. However, the TOT model has not been the most effective in meeting a broader range of development goals that address the multiple functions and roles of farm enterprises and diverse agro ecosystems.
2. Successful education and extension programs have built on local and traditional knowledge and innovation systems, often through participatory and experiential learning processes and multi-organizational partnerships that integrate formal and informal agricultural knowledge systems.
3. Investment in farmers and other rural actors' learning and capacity to critically assess, define and engage in locally-directed development processes has yielded positive results. Modern ICTs are beginning to open up new and potentially powerful new opportunities for extending the reach and scope of educational and interactive learning. Extension and advisory services complement but do not substitute for rural education.
4. Innovation is a multi-source process and always and necessarily involves a mix of stakeholders, organizations and types of knowledge systems. Innovative combinations of technology and knowledge generated by past and present arrangements and actors have led to more sustainable practices. These include for example, integrated pest management, precision farming, and local innovations in crop management (e.g., push-pull in Africa).
5. Partnerships in agricultural and social science research and education offer potential to advance public interest science and increase its relevance to development goals. Industry, NGOs, social movements and farmer organizations have contributed useful innovations for food and agriculture.

(McIntyre et al., 2009)

Civil Society Organizations

Many different types of civil society organizations (CSOs) are playing an active role in the emergent AR4D agenda as active contributors to growth particularly when they have strong routes in the countries.

Non-governmental organizations (NGOs) are voluntary, non-profit organizations providing a wide range of functions:

- i) Some are advocacy and campaign-oriented, and rely on memberships to pay;
- ii) Some undertake projects on the ground, and obtain a mix of income from governments, donor agencies and the public;
- iii) Some have narrow mandates, and some very broad-based; Some are farmer based and others have limited presence or knowledge of conditions on the ground.
- iv) Some are solely based in the North; some solely in the South.
- v) Some in the North have presence in the South either as full fledged entities or through projects.

Civil Society Organizations vary greatly in their origin, financial and human resources, their impact on poverty and environmental outcomes and the likely sustainability of their outcomes beyond the presence of the activities they conduct. Some of the largest NGOs in the North have huge resources and weak on-the-ground presence. Most of those in developing countries operate on very small budgets. They vary considerably in their influence and effectiveness. Some of the largest civil society organizations with huge demonstrated impacts on the lives of the poor are in Asia (Box 8).

Box 8. Civil Society Organizations in South Asia

The Largest Civil Society Organizations originating in national social movements are in Asia. In South Asia their impact and influence is both national and increasingly worldwide. The countries of Southern Asia provide multiple civil societies 'success stories' that have inspired development both within their national borders and around the world. India's **Amul** began as a small-scale dairy program in the 1940s; it has now become a billion dollar brand name that has benefitted the 2.8 million Indian farmers involved in its cooperatives. The 'Amul model' is now being emulated in other Asian countries, as well as Africa and Latin America (Amul, 2001). The **Self-Employed Women's Association (SEWA)**, also in India, was formed as a trade union to protect female garment workers. Since its inception, SEWA has expanded its portfolio and now offers a variety of banking, legal, healthcare, and childcare services to its 950,000 members (SEWA, 2009). Bangladesh's **BRAC** started as an almost entirely donor funded, small-scale relief and rehabilitation project; today it is one of the largest Southern development organizations, reaching over 100 million people in 10 countries (BRAC, 2010). In the area of microcredit, Bangladesh's **Grameen Bank** revolutionized financial services for the poor. Currently, the total number of borrowers is estimated to be almost 8 million, 97% of whom are women. The Grameen model has been a catalyst for micro finance development in developed and developing countries alike (Grameen Bank, 2010).

In South-East Asia, the **Indonesian Forum for the Environment** (known as **WALHI**) is the country's largest and oldest environmental advocacy NGO. Founded in 1980, it unites more than 450 environmentally focused groups throughout the country and works on issues ranging from biodiversity conservation to indigenous rights (FOEI, 2010). Originally a small-scale movement to assist the rural poor, the **Philippine Rural Reconstruction Movement (PRRM)** has been a major contributor to sustainable rural development for over 50 years (PRRM, 2009). Its integrated, fourfold program of education, livelihood, health, and self-governance has inspired the formation of similar national movements in Colombia, Guatemala, Ghana, India and Thailand.

They provide a range of services (e.g. medical, agricultural) to disadvantaged communities including particularly to women. Some conduct advocacy on environmental or rights issues. Some are operational and active in humanitarian relief operations and/or development action. Some combine operations with advocacy. NGOs often act as service-providers in development programmers and are the category of civil society organizations with most presence in UN and international policy forums.

People's organizations (POs) are established by and represent sectors of the population such as small farmers, artisanal fisherfolk, and slum dwellers. This basic characteristic makes them different from NGOs. POs take a wide variety of forms and exist at various levels.

- i) *Farmer's Organizations* of large, medium and small farmers are some of the most active in rural areas of Latin America, Africa and Asia.
- ii) *Community-based organizations (CBOs)* mobilize and represent grassroots populations in both rural and urban areas and directly address their immediate concerns. Examples include neighborhood associations, water-users groups, forest management groups, rural women's credit associations, irrigation associations, catchment management groups. Over the past decade they have increasingly become widespread partners of development assistance programs at the local level. Some 450,000 such groups have been formed since the early 1990s (Pretty, 2003).
- iii) *People's organization platforms* structured above the local community level have been built up by marginalized sectors of the population, over the past decade in particular, in order to defend members' interests in policy discussions and program negotiations at national, regional and global levels. These platforms are not yet sufficiently recognized and engaged by the AR4D system in country programs and projects and in global forums.

Indigenous peoples (IPs) are distinct and diverse peoples and nations that seek cultural survival and wellbeing through the exercise of their human rights and collective rights, including their right of self-determination, their right to development, and their rights to the lands, territories and natural resources they have traditionally occupied and used.

People's movements (PMs) is the term used as an overarching category to include people's organizations and people organized primarily to defend political and cultural identity and rights.

It is clear that for effective AR4D, public and private actors need to act together. For smallholder farmers, in particular, structural issues stand in the way of further progress. Investment in research and innovation must be accompanied by similar investment in infrastructure, training, extension services and other aspects of the value chain to ensure farmers can access innovations put them to use and reap their benefits. The partnerships need to be "multi-directional", including that of capacity strengthening: both parties have something to give and something to receive. Both parties are mutually accountable for maintaining their commitments.

International NGOs are playing a major role in AR4D through (i) helping set the development agenda in donor countries and carrying it through aid and trade policies, (ii) shaping research and development strategies of international organizations and through them of developing countries, (iii) bringing in new perspectives to research and development, (iv) enhancing recognition of research partners in understanding needs of the poor and the environment and meeting public accountability and transparency, (v) playing a bridging role in agricultural knowledge dissemination, (vi) mobilizing local CSOs in the regions and influence practice.

However, increasing the investment and partnerships in agricultural research alone is not sufficient. The past decades have seen significant developments not just in technologies and products, but also in the knowledge itself, such as best practices in crop management. All farmers do not have access to

these developments and innovations, which points to the need to focus on obstacles to adoption and diffusion, an area of agriculture and rural development that has received far too little attention. For agricultural research to truly impact farmers and contribute to the achievement of the MDGs, research must be considered in the broader context of the value chains in which farmers operate and are part of concerted policies. Farmers need access not only to inputs, technology and knowledge; but to transport and finance so that they are effectively able to break the subsistence cycle. Issues around access to training, storage and transport infrastructure or markets are equally important and must be part of the strategy in which agricultural research fits.

Policy Environment and Policy Capacity

The rapidly changed global and local environments for agriculture and rural sectors of developing countries call for ability of each developing country to respond to global integration, the severe effects of climate change on resource poor populations and its increasing cross-sectoral and cross-border interactions in a way suited to their own circumstances. The financial crisis also has highlighted the importance of balance between the roles of governments and markets, between those of the public and the private sectors and civil society, the roles of international and national actors in ensuring security of their own populations. This report has also shown that the microeconomic foundations on which the facades of macro-economic scenarios of poverty and food security are built are weak, particularly in terms of the interactions between poverty and food security and with a variety of natural resources, socio-cultural and external factors.

The External Review of the International Food Policy Research noted the same ambiguity highlighted in this report namely of research that is aimed at reducing poverty generally and that which is directly relevant to food security. When it comes to priority setting at the international level and capacity building at the national level this distinction is important. For the principles of subsidiarity in agricultural research whether scientific or policy research means that the CGIAR's policy research that is aimed at reducing poverty has to be directly relevant to food security (Science Council, 2005). The IFPRI Panel endorsed the principle of going beyond agriculture and food security narrowly defined; however, stressed that IFPRI should focus on areas it is best suited to address, and not extend itself too far. Developing country governments on the other hand have responsibility for reducing poverty in their own countries and use a variety of instruments other than agricultural research to address these issues. They need to build the long overdue need for capacity for research on poverty with the help of the international community, while leaving international research on food security to international centers of the CGIAR.

Box 9. Examples of Outstanding National Research Capacity

The Center for Chinese Agricultural Policy (CCAP) was established in 1995 as a member of the Chinese Academy of Sciences. In its short history, CCAP has demonstrated through its work with a host of other international organizations that it can contribute unique and valuable research to policy debates both inside and outside of China; it is now moving into policy capacity building in South East Asia and Sub-Saharan Africa. China is attracting its best most qualified nationals from abroad in large numbers in a way few countries are doing systematically (CCAP, 2008).

Based in Kenya, the African Economic Research Consortium (AERC) is dedicated to strengthening sub-Saharan capacity for conducting independent, rigorous inquiry into problems pertinent to the management of economies in sub-Saharan Africa. Its dual focus on training and research allows it to nurture the development of local expertise and contribute to African academic and policy communities. Africa needs more such quality institutions (AERC, 2010).

Rural Infrastructure: Roads, Electricity, IT and Water

There are marked regional differences in the capacity of agriculture to generate incomes and reduce poverty. The available capital stock per worker is an important explanation of inter-regional differences in performance. A farmer in Latin America has on average 10 times more capital available than his colleague in sub-Saharan Africa (Schmidhuber et al., 2009). A large range of tools and equipment make agriculture in Latin America much more productive than in Africa, including more and better mechanization, tractors, tillers and combines, irrigation, storage and processing plants, and other elements of an efficient downstream sector. Moreover, Latin American farmers have multiples of support capital in better infrastructure, research institutions, available roads, or electricity. Rural roads per hectare for instance amount to 0.017 km in Latin America compared to 0.007 km, i.e. less than half that distance in sub-Saharan Africa. Likewise, rural electricity supplies per worker are 50 times higher in Latin America compared to sub-Saharan Africa. The poverty reduction potential in the projected revenue/capital stock trajectory in sub-Saharan Africa would thus be limited unless there is substantial investment in the rural sector in Africa. Some analysts suggests that to meet FAO's 2050 projections annual investments of about US\$210 billion gross and US\$83 billion net (after allowing for depreciation of the existing capital stock) would be needed in developing countries in 2009 dollars (Schmidhuber et al., 2009), and declining over time due to increased efficiency in agriculture and decelerating demand for food combined with some substitution of capital for labor.

This includes investments in primary agriculture as well by downstream needs (processing, transportation, storage, etc.). Within primary agriculture, mechanization accounts for the single biggest investment item (25%) followed by expansion and improvement of irrigation (nearly 20 percent). This analysis also poses questions as to what alternative income sources could be tapped in countries with low investment in agriculture. Emerging options include new opportunities that arise from higher energy prices and a production of bioenergy feedstocks; income opportunities from the provision of environmental services; or a greater export orientation of production. All three growth options call for a know-how and a relatively more capital-intensive form of agriculture and thus run counter to the factor endowment that currently characterizes Africa's smallholder structure. One option to overcome these constraints would be through increased investments in resource-pooling institutions.

Financial Institutions

Since the old style directed and often subsidized agricultural credit came into disrepute for having been captured by the rural elite and threatening viability of often government-owned financial institutions, international donors largely exited from agricultural finance at around the same time that they reduced investments in support to food and agriculture. There has however been an explosion of innovation in micro finance with an active role by the civil society and supported by international assistance. This not only includes the leadership of the likes of Yunus and Abed in Bangladesh and Kurian in India (Box 7 previous section), who created innovative development programs to reach women's groups and productive investments in farming and dairying in South Asia: many such innovative schemes have emerged in Indonesia, Thailand, Philippines, and parts of Latin America. Some sprung up with the support of external donors such as USAID and IFAD in small scale private enterprise and by Peace Corps volunteers, but governments of developing countries have also encouraged presence of formal financial institutions into rural areas as a way of expanding the access of finance to rural households.

Concurrently saving and investment rates in all developing countries have increased and are increasingly being integrated with financial markets. Thus saving accounts are being linked to

payments in the national rural employment schemes in India directed at the poorest households involving an annual expenditure of nearly \$600 million or one percent of GDP. The popular conditional and unconditional cash transfer programs are similarly being connected to smart cards and the banking industry.

The use of new information technology in the form of hand held devices and cell phones combined with greater focus on increasing women's access to finance, and on agro-based and other small scale enterprises has provided ample opportunity for innovation including in ensuring financial viability of the new programs.

Many of these schemes however have not yet penetrated to the rural poor in a way they should for lack of collateral in the form of land or other assets. Some recent literature is expressing concern that the "silver bullet" of micro-finance may worsen the human rights environment for women instead of empowering them, unless women's intra-household, social, economic, political situation is better understood (Krain and Bremer, 2009). This has important implications for lending policies, and power and scope of micro-lending together with other investments needed to improve the situation of the poor.

Chapter 5: Partnerships

The dependence on agriculture (to mean crops, livestock, fisheries, forestry, fruits, vegetables among others) by a large number of the poor, even if only a part of the livelihood diversification strategies the poor use to survive, means that effective pro-poor, pro-women and pro-environmental agricultural systems for knowledge and technology generation, delivery, and knowledge sharing in multiple directions are now essential. They are needed *on a large scale* for the development of whole societies and indeed for more inclusive and sustainable global development.

These changes must occur starting at the local, national and regional levels with external actors playing a facilitative role. External efforts can neither substitute nor replace the complex and routine strategizing, planning, implementing, problem-solving and learning needed on multiple fronts which only national institutions and actors can and must do. Thus local, national and regional entities can and must take the lead with the first and successive GCARDS (Global Conference on Research for Development) facilitate their process.

A. GCARD Regional Consultation Priorities and the CGIAR's Strategic Results Framework (SRF) process.

The articulation of the Regional Priorities and the CGIAR priorities is still in progress. Since GCARD 2010, considerable changes have occurred in the way the Regional Priorities are now summarized by the regional authors, as well as in the number of research themes of the CGIAR. This evolution is reflected in the discussion below. The themes in each case are so broad that there is no basis for the GAT to change the conclusion it reached in the draft version of this report discussed at GCARD 2010 – namely, that there is considerable congruence between regional and CGIAR research themes and considerable scope for developing active partnerships. The GCARD 2010 consultations were designed to obtain regional stakeholder inputs into the regional and CGIAR priorities, and to ensure that the formalistic analytical approach used in the CGIAR's Strategic Framework and the process of identification of the CGIAR's Mega Programs were effectively linked with the GCARD process as complementary approaches. The GAT was asked to synthesize findings of the regional consultations and to assess the degree of alignment and ground-truthing of the CGIAR's new Strategy and Results Framework (SRF), both in substance and processes, with the needs and expectations of the partners in developing countries (See Annex D).

The first ever global consultation process for GCARD 2010, undertaken for nearly a year in all major developing regions of the world, was led by regional organizations. Regional research fora APAARI (Asia-Pacific), FORAGRO (Latin America and Caribbean), FARA (Sub-Saharan Africa), AARINENA (W Asia and N Africa), CACAARI (Central Asia and Caucasus), and EFARD (Europe) each have established networks and priorities that emerge from and focus on sub-regional concerns within regions. China and other Emerging Economies likewise contributed their priorities. The “Stakeholder Consultations” were a multi-phased process that consisted of Regional Reviews (conducted by expert consultants), Electronic Consultations (or E-Consultations) and Face-to-face Dialogues, organized by the regional research fora (as reviewed in Chapter 3). More inclusive than ever before, but understandably by no means perfect, the regional consultations drew upon the thoughts and opinions of over 2,000 participants and stakeholders and highlight both the diversity and magnitude of the challenges ahead of the global AR4D system.¹⁵ The outputs of these activities were then summarized in Regional and

¹⁵ Unfortunately, organizational and logistical limitations prevented the proper sequencing of the various events and reporting activities; likewise, the materials produced by the regions were not comparable (as they did not use a standard approach), making the integration and synthesis of information difficult. The GAT

Synthesis Reports, and are included in Annex B.¹⁶ The regional priority areas were extensively discussed during GCARD 2010; post-conference, the regional authors further summarized the priorities around a smaller number of thematic research and process challenges for transformed AR4D. As can be expected, within the context of these common research and process challenges, each region attributed them varying levels of importance.

The identified thematic research challenges include:

- Sustainable agricultural intensification through increased productivity and production of major food crops;
- Effective natural resources management (land, water, biodiversity);
- Diversification of agricultural products and systems: crop, livestock, fisheries, agro-forestry;
- Developing a systems approach to address livelihoods of resource-poor smallholder farmers, especially women farmers;
- Developing resilient agriculture in resource poor or marginal areas through harnessing new areas of science (e.g. biotechnology, communication and information technology);
- Pursuing a comprehensive value chain approach, including the development of markets, with emphasis on quality and safety for agriculture;
- Research on non-agricultural food security, income enhancement and poverty reduction;
- Research on vulnerability to climate change and resilience building by developing adaptation and mitigation measures;
- Policy research on impact of trade liberalization, market volatility, decentralization of markets and intellectual property rights;
- Research on nutritional, and environmental health considerations;
- Research on the impact of changing economies, urbanization, energy security and population demographics on changing food diets and urban agriculture;
- Research on trans-boundary pandemic and zoonotic diseases; and,
- Changing forms of agricultural production and demand.

Regarding process challenges, the following have been identified as common problems that need to be confronted in all regions:

- Advocacy for increased and sustained investments in AR4D;
- Implementing participatory, demand-driven and people-centered research approaches;
- Integrating agricultural, ecological, socio-economic sciences into an interdisciplinary research paradigm;
- Integrating gender, age, ethnicity, poverty and other dimensions of exclusion;
- Strengthening national research and innovation systems, re-vitalizing extension services and enhancing linkages and partnerships between researchers, educators, policy-makers, extensionists, private sector and NGOs;
- Strengthening enabling mechanisms and policies to foster public private partnerships;
- Building human, institutional and research management and communication capacity for more effective AR4D;
- Integrating local indigenous knowledge into the AR4D cycle;
- Using AR4D outputs to inform policy and national development planning; and,
- Institutional rebuilding post-conflict and post-disasters.

recommends that in the future these reviews should respond to a coherent framework and a standard methodological approach such that their outputs can be compared across regions.

¹⁶ For more information on the Regional Consultation reports and activities the reader is referred to the GFAR website.

In Africa the management of risk and vulnerability, land and water management, the development of integrated crop-tree-livestock systems, the generation, management, dissemination and utilization of knowledge, the development and upscaling of technologies to increase food security, linking farmers to markets for increased incomes, and policy analysis and evidence-based advocacy, were specifically highlighted.

The Asia-Pacific region highlighted the need for research on systems based on the three major cereals (rice, wheat and maize), research on livestock (milk, meat, eggs), millets and other coarse grains, oilseeds, pulses, fruits, vegetables, agro-forestry and fisheries. They also emphasized the need for a greater diversification of agriculture using both systems and value chain approaches - post harvest management, value addition (agricultural processing), quality improvement and assuring food safety - to sustainably enhance productivity, rural employment and income of smallholder farmers. Other aspects in need of greater attention include the capacity to manage risk, biosecurity, energy security, soil, water and biodiversity by farmers and other stakeholders. In addition to a focus on women and youth, it was felt that progressive farmers, NGOs and private entrepreneurs, particularly small and medium entrepreneurs should become more involved in the planning, technology generation and transfer, monitoring and evaluation processes for AR4D, and that more efforts are needed also to improve policy dialogue and communication, so that research can be better linked to rural development and farmers, especially the majority smallholder farmers, can be effectively linked to science and markets. In the Pacific islands indigenous crops and farming systems and the atolls require special attention due to their high vulnerability to the impacts of climate change and natural disasters.

In the Central Asia and the Caucasus (CAC) region, the priority needs for AR4D were grouped into five categories: (i) institutional issues, (ii) research issues, (iii) policy issues, (iv) environmental issues and (v) socioeconomic issues. Among the institutional issues, agricultural extension is of the highest priority followed by restructuring agricultural research and education, capacity building, partnerships and collaboration. The priority research issues include generation of improved technology for diversified sustainable crop production in both irrigated and rain-fed areas; water and irrigation management; livestock research including rangelands; horticulture; seed systems; forestry; and mountain agriculture. Among the policy issues, the need for greater investments in agriculture as well as agricultural research, education and extension at national and jointly at regional level is considered the most important, followed by marketing, processing and value addition of agricultural commodities and developing suitable agricultural development policies related to rural employment, land tenure and property rights. Conservation of biodiversity, climate change and desertification are considered the most important issues under the environment grouping. Among the socioeconomic issues, gender mainstreaming was considered the most important in view of the important role that women play in agriculture. Strengthening AR4D with support of the international community is crucial for the CAC region, which is still a transition economy.

In the West Asia and North Africa region, water issues were front and center, with the highest priority placed on food security and productivity issues such as improving varieties to cope with environmental stressors (salt, heat, drought), and increasing productivity of mixed systems, generation of alternative income for smallholders and risk and vulnerability mapping for climate change impacts. Natural resource management is equally important, specifically the conservation and utilization of the region's unique biodiversity, integrated water management and optimization of water productivity. Livestock and fisheries are also priorities for the region, as well as the management of rangeland and property rights for common resources. Under markets and value chain development, the comparative advantages of specific regional products would be a key-focus of research, as well as post-harvest systems, food safety, market access and policies and the role of

agro-enterprises and cooperatives. Solving issues related to the region's gender imbalance in decision making related to agriculture and its development, weak human and institutional capacities, inadequate policies and investments in AR4D and rebuilding AR4D systems post-conflict are also important priorities for the region.

In Europe several main drivers and associated research issues were identified. First and foremost, there was agreement that AR4D needs to focus more on poverty reduction, hunger and associated issues confronting the poor in the region, especially Eastern Europe, and globally. Six researchable themes were prioritized: forecasting, alleviating and mitigating climate change; addressing the growing pressure on the environment due to population growth; energy security – the food or energy dilemma; satisfying the demand for food and changing nutritional demands; forecasting and coping with pandemics; and ensuring the poor are not disadvantaged by globalization and that returns to farming enable viable livelihoods. One of the most important outcomes of the European consultation was agreement on the need to radically strengthen the processes which influence the way research is conducted: greater donor collaboration and harmonization; smarter approaches to prioritizing pro-poor AR4D; greater continuity of research support; greater, more diverse partnerships – cross-discipline and cross-sector; new incentives for researchers and partners to 'translate' research products to user benefits; and more funding for and better 'marketing' of research products through communication. In Eastern Europe, a diversity of development and agricultural issues face rural farmers and AR4D professionals – income poverty in a number of countries; significant levels of relative poverty; low productivity on smallholder farms; isolation of researchers; rural unemployment; and social exclusion.

The Latin America and the Caribbean region defined seven priority subjects and action areas: food and nutritional security; increased production and productivity; diversification and differentiation of agricultural products and services; challenges of climate change; preservation and sustainable management of natural resources; development of bio-energy; and promotion of institutional innovations. It also defined several strategic elements to facilitate implementation of the research priorities and for strengthening regional mechanisms, such as the need to build on existing successful experiences and institutions in the region; promote major integration of public/private sectors, and stimulate greater participation of the private sector in R & D; incorporate indigenous and small scale farmers experiences; improve the interaction of AR4D organizations with communities and other sectors; formalize partnerships and mechanisms for exchange of information and experiences; build capacities of all the actors involved in R & D processes; and the need to promote a greater institutionalization of FORAGRO as the forum for discussion and promotion of institutional change.

The consultations also stress that the developing world's agricultural research systems are currently not sufficiently oriented towards development. The research organizations have not been good at integrating the needs and priorities of the poor in the work of the researchers. Farmers have difficulty accessing new technologies and innovations and they lack organized networks. There is a disconnect between research and extension systems as well as between researchers and policy makers. Many research systems are under-resourced, and even those few that are well endowed are not connected enough with the broader processes of development. These communications also stress that a change is needed in the incentive structures in the national and international research community to deliver impacts on the poor. They stress that the systems need to be more accountable to their beneficiaries rather than sit on the laurels of scientific achievements alone. They note that, currently there are no incentives for the national and international research systems to work more closely with policy makers, with grass-root organizations, or to invest in coordination, knowledge management and communication. Their constituent institutions often have insufficient connection with, and accountability to, their desired beneficiaries. Thus these consultations results, if they are widely subscribed to by all regions, have served as an important *partial* diagnostic needed to

transform the current fragmented agricultural research system for development into a more cohesive one.

Both the regional consultation process and the CGIAR research priority setting processes have had limitations. Some limitations are inherent to the task of priority setting itself, no matter at what level it is undertaken. These pertain specifically to each set of entities, the regional processes, and the CGIAR processes. Each is discussed separately, illustrating the complexity and the magnitude of the task ahead.

Furthermore, the process of alignment has worked less perfectly than was originally intended; nevertheless, substantial progress has been made. Overall the GAT has reached several major conclusions:

1. There is considerable *scope* for convergence between the broad regional priorities and the broad scope of CGIAR priorities as were available from both sides to the GAT.
2. Regional and national organizations are enthusiastic about proceeding with the implementation of their priorities as soon as possible, are keen to take leadership as they rightly should and are looking for external support in financing, management practices, and incentive systems among others which GCARD processes should be set to provide.
3. Clearly all future work on the translation of these priorities and partnerships will come from the regions and their constituent members as the leaders, as appropriate; one would not expect GFAR to have an operational role in these regional matters except to help build capacities of the regions and countries, foster knowledge and learning and thereby improve standards and norms, and help with resource mobilization for partnerships.
4. The last two year's experience since the CGIAR asked GFAR to undertake a regional consultation process and initiated one of its own, while conflictive at times, have proven to be critically important as an initial step for collective actions at the global level. This also offers important lessons for how to develop effective partnerships to achieve accelerated impacts on poverty and environmental sustainability.
5. More systematic approaches, continuity and predictability of the processes will need to be accompanied by strategic leadership and professional inputs to achieve success.
6. Going beyond this first GCARD will require specific criteria and milestones that can be monitored independently. Indeed, GCARD 2010 is the first stage of the road map in a long-term endeavour to achieve meaningful alignment.

The challenge increases because there are no universally accepted standards, norms and methodologies for developing agricultural research priorities *ex ante*. Furthermore, there are no universally accepted ways to show the expected links of research outputs to poverty reduction quantitatively, for all the reasons discussed in the previous chapters and explored more fully below in the section on the CGIAR. Past attempts to do so at the *national* level through international assistance (e.g., through ISNAR and donor advice accompanying loans or grants) by and large had no impacts *on priorities per se*, or on outcomes, except being able to demonstrate them *ex post*. They did however help promote processes which were more responsive to a variety of external and internal factors which the countries faced, leading to a stronger ability of some national systems to respond in terms of priorities as well as to ensure that the delivery systems were in place or could be put in place to achieve high adoption rates and achieve impacts on farmers' fields.

At the national level research priorities tend to be determined by a country's drive and ability to balance a combination of national interests, such as food security, international competitiveness, equity, geography, traditional and changing patterns of consumption and not the least important the external environment. As shown in the previous chapters, the capacities of national systems to place

issues of agricultural productivity growth, equity and sustainability at the centre stage has varied a great deal. So has the ability to borrow knowledge from external sources and adapting it to one's circumstances as distinct from inventing it in one's research laboratories. The ability to use knowledge - whether from farmers as regards zero tillage, or from imported sources as embodied in genetically modified technologies - requires as much sophistication and political will as the ability to conduct new scientific research (Evenson and Gollin, 2003).

The size and capacity of the national systems in terms of human and financial resources *and the nature of political commitment to this process* matters. China, Brazil and India, during the latter's Green Revolution stage, were able to do so effectively and continue to do so, although in none of the cases has the process been without its critics. Similarly, there is a view broadly shared among analysts that the *public* research priorities in the US have shifted substantially since when the Green Revolution occurred and in which they played an active role, to environmental and consumer safety issues and advanced science, requiring no direct impact and long gestation lags (Alston and Pardey, 1995; Royal Society, 2009). The reasons for this reflect a combination of changing international and domestic environment, the growing role of the private sector and civil society, advances in science and the associated value and funding systems established, pressures from the lobbies of consumers, and industry including the property rights regimes. Precisely how and why the research priorities change beyond these broad considerations listed above remains a relatively under-researched area with a few notable exceptions (Alston and Pardey, 1995). Some European commentators on the draft of this paper discussed at Montpellier, however, did not share the Alston and Pardey observation in the case of European agricultural research about the growing gap in the research priorities between them and those of developing countries (e.g. more focus on consumer safety, environmental concerns and more upstream research). This may well be the case but one which can be easily tested using objective criteria.

Furthermore, even in the case of advanced countries, their poor farmers have not been much of a consideration in setting priorities as was well illustrated in the European consultations. Thus while there are many examples of good practice in giving the poor or urban consumers a voice in research, (e.g. farmer participation in plant breeding and selection for traits and characteristics in rice in West Africa [Walsh, 2001], or breeding to meet consumer preferences or processing, transport or storage quality), so far there are very few examples of scaled up adoption of technologies developed by working with small poor farmers and no European examples of attempts or indeed of successes the "participatory" approach has been tried by the CGIAR centers and civil society organizations on a small scale - in part because agricultural research itself is more straightforward when dealing with single issue questions on a measurable scale, rather than complex systems that may not themselves be wholly replicable in other sites. This means national and regional systems have to play an even more important role in the process of research priority setting and implementation.

As argued in Chapter 2, to use such tools requires very substantial investment in the ability of developing countries own institutions to adapt varieties to location specific circumstances with small markets. This is of course what was done in the case of rice in Asia before large scale adoption could be achieved and is being done now in the case of hybrid rice and maize in Asia but it is not a task that the CGIAR centers can do alone without strong and active partnerships with NARS.

The challenges become even more complex when priorities are to be determined at the regional level, due to the well worn issues of sovereignty, cross border competitiveness and trade, among others. Competition for natural resources including particularly water would be another major factor among neighbouring countries. They would not necessarily want to share the considerations that enter into their own priority setting processes. Furthermore, most regional organizations discussed in

Chapter 3 are weak by their own admission from this perspective. Furthermore regional cooperation in the conduct of research as distinct from networking is relatively new.

Now through the GCARD process all regional associations have made their priorities. However critics including during the regional consultations have noted that these priorities are largely set by NARIs, rather than by a broad set of stakeholders including civil society, the private sector and university community.

The GFAR initiated regional consultations for the GCARD went some distance to correct this bias. Hard facts and analysis of the scope for cross border regional collaboration within the context of the limitations listed above should ideally form the basis for the resulting set of views and analysis.

From this perspective, there is scope for improving the regional processes on the standard approach GFAR provides to the regions for consultations in the future. It was interpreted differently in different regions. This led to significant diversity in the treatment of issues within and across the regions. To add to the complication, different stakeholders attended different meetings within each region. This increased participation obtained strong buy-in within each region and across a wide range of stakeholders in each region but the downside of this approach was that the same issues could not be pursued systematically within each region in depth over time. GAT was unable to assess the extent of participant bias, as distinct from perception bias, from the outcomes of consultations within the same region, or to distinguish between opinions of participants and evidence based analysis.

Despite all these limitations a large number of important insights emerged from the regional consultations, from which GAT drew the following conclusions. Many of these are shared by regional stakeholders as their recent communications to GAT suggest.

- Agricultural research in developing regions is not conducted with sufficient considerations of poverty or environmental sustainability at the centre stage.
- Research systems need to become more responsive to their clients who have little voice.
- Research is a blunt instrument to achieve poverty reduction, even under the best of circumstances, i.e., even in conditions in which the research and innovations systems at large are responsive.
- Not all agricultural development needs can be translated to agricultural research priorities.
- Not all legitimate needs call for more research.
- Barriers at the country and local levels both to technology transfer (teaching), and to co-creation of knowledge (learning from and with the poor), and more generally to poverty reduction tend to be considerable, but must be confronted and addressed.
- The GCARD process can help with appropriate realism about the time and the quality of effort that will be required. The foregoing considerations dictate that:
 - Investments in productivity enhancing research for development were an essential but by no means sufficient condition for addressing the major challenge of sustainable poverty reduction.
 - Innovative policies and institutions that exploit the broad range of technological advances, especially information technology, in building and maintaining rural roads, power and energy, secure land rights, education, and increased social capital, were just as, if not more important, to enable knowledge and innovation to impact on people's livelihoods.
 - The required policies and institutions in bullet points #2 and #3 above are typically largely the domain of a whole range of sectors in each country that lie outside of the agricultural research institutes, or indeed even of NARS broadly defined. Finally,

- There are issues of comparative advantage of the CGIAR with respect to other actors in these areas within developing countries and the CGIAR; both must address frontally.

Which specific issues should be assigned high research priority, the appropriate balance between advanced science and indigenous knowledge, and between agro-ecological and biotechnology approaches to achieve the desirable productivity increases will have to be sorted out by the regions. A more inclusive rather than an “either-or approach” to research and technology generation is needed (Royal Society, 2009). However operationalization of this principle is the sovereign domain of each country and its stakeholders. Substantial effort to develop the necessary human and institutional capital for priority-setting and policy formulation and implementation is needed for countries to choose their own paths.

At its first face-to-face meeting with senior managers of the CGIAR in Rome 10-12 February, 2010, the GAT was able to confirm that, at the broad level, there was no inconsistency between the regional priorities and the then 8 CGIAR Mega Programs that were the basis of the SRF at that time: Agricultural systems for the poor and vulnerable; Enabling agricultural incomes for the poor; Optimizing productivity of global food security crops; Agriculture, nutrition and health; Water, soils and ecosystems; Forests and trees; Climate change and agriculture; and Agricultural biodiversity). The GAT concluded that this level of convergence could lead to a significant alignment of priorities, recognizing that the scope of preferred capability of the CGIAR does not cover all areas of agriculture. But as stated earlier, both the SRF and the number of research programs is still evolving, with the latter having already reached 15, in a process of successive disaggregation of the original broadly defined themes referred above, to more focused instruments.¹⁷ The general conclusion of a considerable *scope* for convergence between the identified regional priorities and the scope of CGIAR priorities as reflected in this new research portfolio is, however, still valid, and further discussion will have to wait until the now called CGIAR Research Programs (CRPs) are fully developed.

In this context, the task of delineating and identifying the specific areas for functional collaboration, is complex and must actively involve NARS given the technical and political challenges inherent in this process and the reality that the national systems are the ones who have direct responsibility for development outcomes, rather than the international system. How complex it can be can only be best understood, first, by reviewing the experience of and the lessons from the CGIAR’s current reform process done in the next section.

Moreover, what GCARD is aiming for is unprecedented. There is only a limited past history or experience at the regional level in priority setting, or in systematic *systemic collaboration to conduct long term research for mutual benefit among the countries the multiple stakeholders involved and the CGIAR past the Green Revolution period. With the funding crisis in the CGIAR and decline in investment in agricultural research and development by donors in most developing countries since the early 90s the Modus Operandi on collaborations have changed even though the rhetoric of participation has increased.* On the other hand regional associations too will need to build regional cooperation in research to achieve demonstrable results, a tremendous opportunity. Can learning lessons from each other in priority setting approaches expedite alignment? These issues are discussed in the section following the CGIAR processes.

B. The CGIAR Reform Process

CGIAR’s revised Strategic Framework paper was being written up at the same time that the GAT was finalizing this report. The GAT has not seen the new revised document. This section is based on the

¹⁷ For further information on the CGIAR Mega Programs, now called CGIAR Research Programs, please visit <http://cgiarconsortium.cgxchange.org/home/strategy-and-results-framework/megaprograms>.

SRF produced in November 2009 and may have to be updated once the CGIAR SRF is disclosed at GCARD and discussed.

It should not be surprising that the quite large and ambitious *current* reform process of the CGIAR system as a whole is taking longer to complete than was envisaged when the GCARD/GFAR process of regional consultations was first proposed in 2007. The description of the current process illustrates the complexity of reforms not just at the level of the CGIAR but in the transformation of the global architecture of research for development. How the CGIAR reform process is managed and the resulting reforms implemented have implications and lessons for the future priority setting processes and their implementation. These lessons would not just be for the CGIAR system; the current reform process will also show the ways in which the CGIAR implicitly or explicitly: sets best practice for reforms and standards for priority setting and partnerships in strategic areas of collaboration, responds to developing countries' needs, and demonstrates learning on a continuous basis from the dynamic research and action oriented organizations and stakeholders in developed and developing countries alike.

The CGIAR reform process has not been linear. It has involved reconciliation of numerous and at times conflicting interests which have in the past thwarted similar reform efforts, starting with the first independent external evaluation of the CGIAR carried out by Maurice Strong and subsequently (World Bank, 2003a).

The CGIAR SRF has been evolving rapidly making it difficult to discuss CGIAR priorities "alignment" with other areas of reform, and certainly more difficult to determine areas of convergence with the regional priorities emerging from the GCARD processes.

The CGIAR has had a phenomenal track record of successes in increasing agricultural productivity on existing lands, and contributing to creating on and off farm employment, food security at the national and household levels by increasing food supplies, and to reducing food prices. This has been consistent with its mission as reflected in its latest vision, namely to– *reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high quality international agricultural research, partnership and leadership*. A large literature documents its substantial pro-poor impacts (Adato and Meinzen-Dick, 2007; Thirtle et al., 2003).

The fifteen semi-autonomous Centers of the CGIAR focus on a range of activities in pursuing their specific research agendas. Their mandates range from achieving productivity growth of a very limited number of specific crops, livestock, and fish commodities, to research on multiple commodities within production systems in specific agro-ecologies. Still others concentrate on research related to natural resource management or on policies. As Renkow and Byerlee (2010) note "not surprisingly for a system encompassing such a highly diverse portfolio of research activities, some Centers have been more successful in generating positive measurable impacts than others. Even certain programs within otherwise very successful Centers, have at times suffered rather poor records in terms of returns on research investments. Some of this is attributable to normal cycles in scientific discovery. But there is growing concern that slow growth in funding reduction in core funding since the early 1990s, in conjunction with an expanding portfolio of research initiatives, has eroded the System's effectiveness in fulfilling its various objectives" (Robinson and Elliot, 2007). Various CGIAR evaluations (e.g. the World Bank's Meta Review 2003 and the latest Independent External Review, *Bringing Together the Best of Science and the Best of Development*, 2008) have noted the downward drift of the CGIAR, its mission creep, a large number of small projects, an increasing level of funding tied to individual projects and weak impact (World Bank, 2003a; Robinson and Elliot, 2007). Indeed, the CGIAR itself recognized these weaknesses and embarked on a far reaching reform process scheduled for implementation in 2010" (Renkow and Byerlee, 2010).

A New Model for the CGIAR

The following is quoted directly from the CGIAR website (2010). "In 2008, the CGIAR launched its Change Management Initiative to identify how best to adapt to and anticipate the global changes and challenges and thereby ensure the continued supply of international public goods to help address them. This initiative culminated in the CGIAR's decision in December 2008 to adopt a new business model that will enable the CGIAR do more and do better, as it fulfills its mandate to fight poverty and hunger while conserving the environment".

"Guided by a new vision and three people-centered strategic objectives, the agreed reforms will strengthen the CGIAR by establishing a results-oriented research agenda, clarifying accountability across the System, and streamlining governance and programs for greater efficiency. Taking a more programmatic approach than in the past, research will be conducted through "Mega Programs" that bring CGIAR scientists and partners together to address critical issues and deliver international public goods that advance global development objectives."

"The core elements of the new CGIAR will be the Fund and the Consortium of the CGIAR Centers. The Fund will harmonize donor contributions to improve the quality and quantity of funding available, engender greater financial stability, and reverse the trend toward restricted funding. The Consortium will unite the Centers under one legal entity and provide a single entry point for the Fund to contract Centers and other partners for research products."

What Priorities, Who Sets Them and How?

The Alliance of CGIAR centers commissioned a small team from within the CGIAR family to prepare comprehensive new strategy for the CGIAR in late 2009, now referred to as the "first Strategy and Results Framework that spells out its programmatic focus" to meet the concern that the CGIAR needed to elevate its game to have larger and more rapid impacts on poverty reduction than it has had so far. The SRF was issued by the CGIAR for its last Business meeting held in November 2009 (CGIAR Strategy Team, 2009). The preparation of the SRF and its manifold iterative processes amply illustrate the complexity of the challenges the priority setting process presents within the CGIAR and its ownership by the centers including for defining Mega programs.

The preamble from the Alliance Board Chair and the Alliance Executive Chair of center directors noted that "the time constraints meant that consultations with partners, stakeholders, and within the Alliance were limited in scope". The preamble also noted that the Alliance supports the broad strategic framework with certain caveats, but stressing the need for further elaboration of the evidence base, the philosophical underpinnings and the logical framework for deriving a portfolio of MPs from the strategy (CGIAR Strategy Team, 2009). The Alliance also recognised that "*stakeholders' involvement and inputs are essential, before the strategy and the mega-Programs and moving forward "will ensure that the necessary consultations are effective and linked to the GCARD process"*. It noted that the very concept of MPs requires further clarification, to establish a clearer basis for operationalization of the portfolio" (CGIAR Strategy Team, 2009).

Numerous additional comments on the SRF document are contained in the "synthesis of comments on the strategy team's final report and progress report #4" at the end of the SRF. These comments and the SRF itself illustrate the challenge in reconciling the views of different stakeholders of the system, i.e., the CGIAR centers, the science council, the donors, new and emerging Alliance and Consortium leadership, and other stakeholders, e.g. civil society and most importantly, the developing countries. The SRF must therefore be clearly seen as work in progress and still expected

to undergo extensive revision including aspects related to the identification of generic pathways with regards to poverty alleviation, sustainability and world food security, partnerships and how the CGIAR should position itself with national governments, national agricultural research systems the private sector and NGOs, boundaries and interactions among CRPs, principles of governance and management, monitoring and evaluation and how the SRF incorporates the Montpellier road map, among others. In this present cycle, however the existing list of 15 CRPs is not expected to undergo further review.

SRF Substance: Many Expectations

The strategy builds on three core system objectives (sub-goals): i) creating sustainable increases in productivity and production of healthy food (food for people); ii) sustainable use of natural resources and biodiversity (environment for people); and iii) promotion of policy and institutional change for agricultural growth and equity (policy for people).

To produce “strong and compelling SRF and Portfolio MPs”, the then Alliance Board Chair and the Alliance Executive Chair spelled out the impossible expectations regarding MPs in the preamble:

- It will have clear impact pathways
- It will address one or more strategic objectives
- It will have sufficient scale to deliver on results and measurable impacts
- It will reflect the CGIAR’s comparative advantage in leading/catalyzing research
- It will effectively mobilize resources, capacity and synergies among partners
- It will have an investment time horizon of 6 to 20 years.
- It will have a simple and cost effective mechanism.

The distinguishing features of the strategy compared to “Business as Usual”

- It is a strategy for the whole system, since no explicit strategy existed before,
- Is “results oriented” which the CGIAR did not have before,
- Focuses explicitly on poor people—rather than the current implicit one, and
- addresses current and emerging threats of the global food system on a scale,
- Its global public goods nature of the proposed research provides rationale for scaling up overall funding of the system as a whole, and
- Includes a concept of partnership *at a system level*, which needs to be further developed with partners
- Includes gender at the system level, and
- Proposes some important new research programs to achieve the defined results. While proposing themes which will “tap synergies across the system”, it de emphasizes some ongoing activities (CGIAR Strategy Team, 2009).

The Mega Programs, called the CGIAR Research Programs (CRPs), at the time of publication

The mega programs were the building blocks of the new CGIAR strategy, together with two platforms –gender and capacity-strengthening that will cut across Mega Programs. The Mega programs in the first SRF document were based on a combination of mapping of poverty and production systems together with IFPRI’s modelling adapted to address system needs.

The Changing List of Programs

The SRF in its initial version contained seven programs. An additional one was added to produce this list:

- agricultural systems for the poor and vulnerable
- enabling agricultural incomes for the poor
- sustainable crop productivity increase for global food security
- agriculture, nutrition and health
- water, soils and ecosystems
- forests and trees
- climate change and agriculture
- agro biodiversity (but included genomics in a meeting of donors)

The list on September 20, 2010 was:

- **CRP1.1** Integrated agricultural production systems for dry areas
- **CRP1.2** Integrated Systems form the Humid Tropics
- **CRP1.3** Harnessing the development potential of aquatic agricultural systems for the poor and vulnerable
- **CRP2** Policies, institutions, and markets to strengthen assets and agricultural incomes for the poor
- **CRP3.1** WHEAT-Global Alliance for improving Food Security and the Livelihoods of the Resource-poor in the Developing Word
- **CRP3.2** MAIZE –Global Alliance for improving Food Security and the Livelihoods of the Resource-poor in the Developing World
- **CRP3.3** GRISP-A global Rice Science Partnership
- **CRP3.4** Roots, tubers and bananas for Food Security and Income
- **CRP3.5** Grain Legumes: enhanced food and feed security, nutritional balance, economic growth and soil health for smallholder farmers
- **CRP3.6** Dryland cereals: Food Security and Growth for the World's Most Vulnerable Poor
- **CRP3.7** Sustainable staple food productivity increase for global food security Livestock and Fish
- **CRP4** Agriculture for improved Nutrition and Health
- **CRP5** Durable Solutions for Water Scarcity and Land Degradation
- **CRP6** Forest and Trees: livelihoods, landscapes and governance
- **CRP7** Climate Change, Agriculture and Food Security

The reviewers of the first SRF raised concerns about insufficient clarity in the SRF between the objectives, programs, its outputs and eventual impacts. That is if one accepts the SRF's technocratic logic built on a model and mapping of poverty.¹⁸ In reality impact pathways while a very helpful way to plan research projects and even programs are impossible to determine ex ante at a systems level. Large poverty outcomes are not only difficult to determine using existing data but they depend on a complex set of factors as shown in chapter 2 and in the regional consultations.

¹⁸ Using a modelling and mapping approach superimposing poverty on top of resource availability and infrastructure, compared to the baseline scenario, the SRF projected, "the high investment comprehensive scenarios with improved research efficiency, irrigation, natural resource management and market access could reduce the price of maize by 22% in 2025, wheat by 17% and rice by 13%. By lowering prices.....such a scenario.would reduce the number of undernourished children in developing countries by 17 million in 2025" 9(CGIAR Strategy Team, 2009: xiv).

While some themes had been retained from the earlier list, some new were added since the SRF was first issued. At the time of release of this paper four proposals have been fast tracked and only two – rice and climate change – are at the final decision level, with the remaining at different stages of advance.¹⁹

The Struggle between the New and the Old

This reform process is facing many of the issues the previous CGIAR reform efforts have faced. First, the Mega Programs contain themes on the work that has already been underway in the CGIAR in addition to that “needed for scaling up and improving the efficiency of agricultural R and D in general and the role of the CGIAR in particular” (CGIAR Strategy Team, 2009: xiv).

Second, they pose the dilemma between Fast Tracking of the Strategy as a whole, compared to getting some Mega Programs underway on practical grounds.²⁰ A similar dilemma during the Change Management Process in 2000 had led to the fast tracking of three or four Challenge Programs. The original intent was to have a larger number of challenge programs all advancing rapidly as a way of reforming the system of centers by stealth. It did not occur in part because it takes time to prepare programs of different complexity, e.g. on climate change or water compared to rice and wheat. In part it is resistance of reforms since some programs or indeed even centers will have to be eliminated.

The current reform process also raises additional more important questions about the process of design, the amount of money and the issues of leadership and partnership discussed in the last section of this chapter.

Leadership Issues

The new leadership is just getting started:

- i) A New CEO of the Council was recruited in September.
- ii) A newly created Science Task Force of the Consortium Board (CB) is being established with a role in recommending the APPROVAL of the SRF and MPs to the full consortium Board –at the May 23-25th CB meeting. The SRF authors noted that the strategising “will continue in the context of GCARD processes and... will require strategic leadership by the Consortium Board”. This should now be possible with the new appointments.

On Scientific Advice

Strong and independent advice to the System is critical for its integrity and continued impact.

The role of the Science Council, which is expected to report to the Fund Board, is unclear including what will be the relationship between the Science Council and the CB Science Task Force. SRF will need *advice by independent bodies and reviewers to move the strategy and Results Framework to coherent implementation by the Centers*” (CGIAR Strategy Team, 2009).

¹⁹ The first list included Agricultural systems for the poor and vulnerable, institutional innovations and markets, genomics and global food crop improvement, agriculture nutrition and health, water soils and ecosystems, forests and trees and climate change.

²⁰ The authors of SRF cautioned *against fast tracking with a few selected Mega programs*, on grounds that such incremental fast tracking of a few “could undermine the potential synergies among the Mega Programs in the system context. Still fast tracking of the portfolio can be done because all Mega Programs have elements that can be fast tracked” (CGIAR Strategy Team, 2009).

On Funds

The SRF estimated that the public agricultural R and D investments for developing countries would need to increase from the current \$5.1 billion to \$16.4 billion in 2025, and a significant proportion of it would need to go to regions where poverty is concentrated, i.e., South Asia and Sub-Saharan Africa. This will necessitate a combination of increase in government expenditures on R and D and need for reallocation among regions by donors. Some regions (e.g. South Asia) are less aid dependent than others (Sub-Saharan Africa). Still others are even less aid dependent (e.g. East and South East Asia) than South Asia. This will mean persuading policymakers in those countries to respond to CGIAR initiatives with their resources. Besides not all donors would be willing or able to accept such global reallocation (see SRF for synthesis comments by regions on the allocations).

Allocations to the CGIAR : Zero Sum Game without Increasing Investments in Developing Countries

Unless complimentary investments are made in developing countries, the CGIAR's partnerships will suffer and the CGIAR will see working with partners as a zero sum game. The estimated investments in R and D include the investment needed *in international public goods* as well as national public agricultural research", with a \$1.6 billion CGIAR, tripling its current size by 2025. Regardless of what the actual numbers would be many of the points of principle made in this report that substantial investments are needed in R and D in developing countries to reduce poverty is undisputable.

International vs. National Public Goods Research

This issue is central for effectiveness of partnerships as outlined in earlier chapters.

The CGIAR has been steadily moving downstream and a majority of the NARS have been steadily drifting downwards. The cause and effect of the two are unclear. But the result has been limited impacts on poverty reduction. The SRF does not clarify how much of the proposed research in the SRF by the CGIAR centers would indeed be of an international public goods nature, an issue discussed in the second half.

Precisely how these incremental investments in R and D are to be achieved at the CGIAR level as well as the level of the NARS, which the SRF correctly identified as being critical to achieve impacts, is an important issue which the CGIAR's research programs and its partners would need to address.

Furthermore, as this report makes clear, just investing in R and D alone will not be enough. Substantial investments would be needed in the development of infrastructure, markets, human capital among other things which are not covered in the SRF.

C. Leveraging 100 percent through Partnerships: Principles and Lessons of Experience

Clarity in Terms Influence Clarity of Partnerships

Partnerships have become popular and have proliferated. In international cooperation they have often become a politically correct form of *modus operandi*. The concept is widely used and often abused. IEG's Evaluation of global programs (2007) has shown that a growing amount of international assistance is going to establish partnerships through the uses of trust funds. The World Bank alone is engaged in nearly 170 global partnerships and the number has grown, most recently in the area of environment. Donor recipient relations are described as "partnerships" when in reality they reflect more an aspiration than a reality. Global program partnerships have most impacts when

there is commensurate investment in developing countries to achieve results as in the case of GEF, the Global Fund for ATM, GAVI or the CGIAR of the past. Whereas conditions on developing countries to “change behavior” have increased, there is less monitoring of the changes in the behavior of donors than of recipients (Picciotto, 2009). Even the terms such as partner and participant, member and subscriber are often interchangeably used causing much obfuscation in the reality of partnerships (World Bank OED, 2004). Clearly and understandably the concept of partnership means different things in different contexts, but needs to be clarified in specific contexts.

The same is true for the use of the term international public goods (Box 10) (World Bank OED, 2004), e.g. poverty alleviation is now often considered an international public good. While it is good to reduce poverty, with the loss of meaning of the term, many types of activities carried out under global programs generally including in the CGIAR centers are described as international public goods, creating more confusion rather than clarity in the roles and responsibilities of different actors, e.g. national governments or stakeholders compared to international institutions. Its profound implications are also often underappreciated including particularly impacts on resource allocation. Many activities which should ideally be carried out at the national or local level by stakeholders are financed and carried out by international organizations in the name of providing international public goods whereas there is under investment in building the national capacity of countries. Governments’ neglect of their own rural areas has often compounded this problem. Donors keen to show quick impacts of the uses of their funds are tempted to allocate them to achieve quick short term results.

Box 10. An International Public Good

Public good is non-rival (i.e., one person's enjoyment in no way degrades the availability or quality for others) and non-excludable (i.e., anyone in the relevant population can enjoy it). Some public goods must be produced or provided (e.g., knowledge, a new technology) while others must be conserved or protected (e.g., forests or the existence of species); some may be both produced and conserved (e.g., genetic material). The "international" modifier restricts the relevant set of public goods to those relevant to multi-national populations. The primary justification for this more restrictive spatial definition arises from the fundamental design principle of subsidiarity, which stipulates that any sort of spillover – of which public goods are one particular form - should be handled by the agency possessing the necessary technical capacity whose functional and geographic mandate most closely match the functional and geographic reach of the spillover. International organizations such as CGIAR Centers are thus tasked to provide international public goods only, leaving more localized public goods to more localized entities. But the public good is the knowledge generated, not the location in which that knowledge is generated. Well designed studies fielded in only a few specific locations, even within a single country, can generate knowledge of quite general, international value (Barrett et al., 2009).

The purposes and objectives of individual partnerships are also often not well defined in practice (IEG, 2007) nor are they adequately and independently evaluated, even though there are serious and growing issues of governance, accountability, representation and voice in using the instruments of partnerships (Picciotto, 2009). Upon having identified such issues in its evaluation of global programs based on partnerships, the World Bank’s IEG developed principles and guidelines for evaluating global programs, while not perfect they have made a beginning in defining concepts and principles by which partnerships should be evaluated and by implication should be designed. There is much now that can be learnt from what is known and not known about these partnerships and their implications for the transformation of AR4D including the design of the Mega Programs, now being called themes, in the context of regional priorities.

As noted in previous chapters, partnerships, including those of the CGIAR, come in many forms. They can mean a joint venture which is not for profit, or a business venture with shared costs, shared risks

and shared profits and losses. Partnerships can mean active collaboration, or cooperation between groups working together, or a formal or informal relationship between two or more scientists or organizations involved in the same activity (World Bank OED, 2004; IEG, 2007, 2008). Partnerships can be those with accountability to partners alone or those with accountability to shareholders (funders) or stakeholders (funders, intended beneficiaries) or those who are potentially likely to be adversely affected by the activity) or all of the above (World Bank OED, 2004; IEG, 2007).

World Bank's OED Global programs are partnerships and related initiatives whose benefits are intended to cut across more than one region of the world and in which the partners (World Bank OED, 2004):

- Reach explicit agreements on objectives
- Agree to establish a new (formal or informal) organization
- Generate new products or services
- Contribute dedicated resources to the programs

In reality, true working partnerships are of course much messier than the attributes listed above suggest. Objectives evolve over time when partners work together or external and internal circumstances change. Funding does not always materialize, time tables slip, learning from experience results in redesign etc. Nevertheless the presence of a formal framework results in making explicit what is often implicit, in terms of what is needed for a true partnership to deliver results.

These types of partnerships are potentially far more “valuable” than pro forma partnerships, or those which largely entail contracting out , i.e., one actor implements the contracted activity on behalf of the other, some time also described as outsourcing the work to be performed to others, however without a voice. Even in the latter case comparative performance among alternative contractors for similar tasks is possible as in the case of GEF contracting out its work to executing and implement agencies.

Such structured partnerships are also distinct from a formal or an informal alliance, relationship or a network whose impacts are more difficult to assess. Yet there have been good evaluations of the CGIAR's INGER network whose activities had substantial benefits of networking and learning from each other to the scientists in partnering countries.

Hence the concept of participation is equally important. Again participation can mean information sharing, consultation, involvement, empowerment, and voice in decision making. The term participation needs to be spelled out.

Partnerships have costs as well as benefits. Costs of partnerships particularly to developing country partners are often very high given their limited capacity but are often under estimated including the opportunity cost (or the defacto impact) of participating in some externally initiated activity in not being able to implement the countries' own priorities (IEG, 2008).

Why Partner?

Partnering can increase relevance of an activity or a product by better understanding the client's needs and the potential “market” for products and services of a research program.

Partnership can increase efficiency—by turning to a partner who has greater knowledge and skills, usable products or services *or can conduct the same activity at a lower cost.*

Partnership can increase efficacy—e.g. by producing the product where the clients are, or where the materials are closer to the clients.

Partnerships can help increase impacts by drawing on the experience of partners, expanding the size of resources, bringing in more technical or cultural knowledge. As resources have become scarce and number of actors have increased partnerships have become a way of sharing resources where partners compete with each other more than cooperate.

Since many times developing countries are asked to “partner” to increase legitimacy of an activity, however without building their capacity, without providing them the resources in those cases where their own countries’ ability to contribute is limited, or without thinking of the opportunity cost of the use of such “partnerships” to developing countries, it tends to result in the race to the bottom.

The reason the World Bank’s evaluation of development effectiveness shows the Bank being more effective in stronger countries is because the countries have the capacity to set priorities, to just say no and engage only in those activities which are of importance and which they can implement. This requires investment in building the countries’ capacity simultaneously with engaging in partnership with them. Therefore capacity building aspects of a partnership needs careful definition, performance indicators, regular monitoring and evaluation.

Public Goods tend to be undersupplied because it is difficult to generate collective action among actors, including particularly countries developing countries when the costs of provision are borne locally and benefits are largely captured nationally or globally. This was the reason why the CGIAR was funded internationally. But sadly the CGIAR’s funding of true international public goods has diminished while its development activities have increased for the reasons pointed out above.

Four different types of public goods provision

Best Effort approach –entails mobilizing the best technology to assure quality provision of a product which could not be generated by developing countries (and increasingly the CGIAR with its diminished capacities relative to rapid advances in Science) acting alone. Using advanced genomics to produce plant varieties or vaccines falls into this category. The production of upstream products does not need country participation at the upstream stage but will be needed when technology is being released.

Weakest Link—Inaction by a single actor or a country can undersupply the provision of an entire public well –e.g. in the case of communicable diseases or pests, inability of one country to act could undermine the effort. A program assesses the vulnerabilities in countries and helps to prevent them from turning it into a contagion

Aggregate Effort—a critical mass of countries, each contributes to a GPG, such as adoption of varieties or the management of water resources.

Coordination and Establishing Formal and Informal Standards—countries act in harmony to jointly achieve an agreed GPG. Doing research which outlines costs and benefits of not acting and serves as an umbrella for international action (IEG, 2008).

Partnership Principles for Adherence

Box 11. Concepts Relating to Setting and Achieving Priorities

Concepts Relating to Setting and Achieving Priorities: Essential for Planning and Evaluating Partnerships

“Comparative advantage describes the ability of one economic actor (e.g., the CGIAR System) to produce a good, service, or knowledge at a lower opportunity cost than another economic actor. Opportunity cost is the cost of forgoing one activity in favor of another, measured in terms of those goods, services, or knowledge whose production is forgone.

Dynamic comparative advantage describes how an economic actor may develop new comparative advantages over time as a result of new investments, learning by doing, or comparable changes experienced by other actors.

Core competence refers to an economic actor’s unique set of assets that cannot be replicated easily by other actors. These are typically specific production resources, technological and managerial capabilities, or reputational integrity that help actors gain an advantage over competitors.

Collective action dilemma refers to the difficulty that rational, self-interested members of a group experience in achieving their common group interest, unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest.” (World Bank OED, 2003a: 2).

Partners need to play up to the Comparative Advantage of Individual Partners

National systems must be in the leadership position if achieving development impacts is the objective, whether on a scale or not. Similarly, the CGIAR needs to engage in research only when it is providing a global or regional public good which national systems are unable to provide even if they are strengthened to do so. If the countries have the responsibility to provide such public goods then they must be strengthened first and foremost, with others taking on a time bound effort at provision with a clear exit strategy combined with adequate resources for the creation of capacity.

Partnerships need to determine the opportunity cost of engagement in partnerships in any activity. If engaging in one activity generates donor or government resources but then results in under investment in research and development in some other equally or higher priority activities which only the international centers or only the national actors can perform best, then the implicit or potential loss of “value added” should be determined before engaging in a partnership.

The minimum number of essential partners needed for a particular piece of research and development ought to be determined. The combined experience of many of the past CGIAR intercenter, systemwide, ecoregional and challenge programs –reviewed in at least 22 science council reports for this paper suggest that there are many more partners than resources to fund them adequately. But often they engage in a partnership because it helps to get a share of the pie of limited resources. Whereas *a priori* definition of the exact set of partners may either not be possible, or may limit innovation because it is not usually feasible to foresee each of the partner’s roles, common-sense rules can be established about how to limit duplication among partners.

In upstream research the number of partners may be limited. In natural resources management research (NRM), systems boundaries need to be placed more broadly to improve the chance that research has impact for development. Thus, NRM typically needs to involve a range of partners whose roles are not always strictly defined from the outset. Thus whereas the partnership is to create content of research and not just a tool for doing research, the way the partnership may still plan on delegating activities, providing resources, building capacity and expecting the under

resourced partner to over time deliver more should be explicit in the design of partnerships. This should particularly include indicators for increasing capacity through partnerships.

Future Partnerships need to meet the challenge of combining top-down and bottom-up priority Setting. Top-down priority setting, uses global, regional or national statistics and policies and opinions of representatives of national stakeholder groups. Bottom-up priority setting, works with a farming systems approach and participatory approaches, analyzing constraints and opportunities and their causes and building *priorities of and for communities and small regions*.

Consolidating the needs of a very large number of communities into a national picture is often not attempted systematically to determine if engagement in large scale research is likely to generate principles in NRM of use across national borders or regions. If the target is international, then the challenge is even greater. The attempt to design methodologies, often end up being bottom up processes which could just as easily have been undertaken by national actors without adding value and at a higher international cost because the participation of international actors through tied funding greatly increases the cost of research which institutions at local and national level as partners could do more effectively if their capacity was developed simultaneously. This approach also threatens sustainability of the interventions beyond the presence of international actors.

Implications for Future Partnerships between the National and Regional Systems and the CGIAR

- Clarify the use of terms used in designing an R and D program in a specific context
- Define not just the objectives but the terms of engagement
- Clearly identify potential value added, roles and purposes of engaging with each partner involved in a partnership
- Determine their implications for resources, responsibilities, and accountabilities of each partner
- Provide for transparent governance, monitoring, reporting and evaluation arrangements for each partnership
- Explicitly determine the investments needed for capacity building of developing countries and generating outputs with a high probability of success on achieving poverty impacts.
- Maintain a clear record of partnerships. EMBRAPA established and maintained an inventory of types of partnerships it engages in to assess changes in the nature of partnerships and their results (see Annex C).

Chapter 6: Conclusions and a Road Map for TAR4D

A. Conclusions

This report underscores the importance of the collaborative effort that led to GCARD 2010 and further highlights the challenges of achieving convergence between GCARD regional priorities of developing countries (now consisting of about half of the 96% of the global public research system in the developing world and the CGIAR's Strategic Results Framework and thematic areas or Mega-Programs (representing the remaining 4%) The following conclusions emerge:

1. The importance of GFAR moving expeditiously to facilitate regional and national organizations to operationalise the priorities they have identified through regional processes to reorient their own research, technology and delivery systems to meet small and marginal farmer needs and constraints, including particularly the need of poor women farmers.
2. The importance of improving both the processes and substance of priority-setting based on agreed principles and standards with common goals of accessing existing technologies for further adaptation and/or generating new technologies geared to small and marginal farmers for environmentally-sustainable food security and poverty reduction.
3. Acknowledging the lack *generally* of universally-accepted standards, norms and methodologies for developing agricultural research priorities *ex-ante and particularly those which are inclusive of the small farm households*, and therefore the urgent need to develop a menu of good practices and options that can be shared with research managers across a broad spectrum of heterogeneous conditions and institutions faced by small and marginal farmers.
4. The need for stronger analytical underpinnings of research priorities at all levels to assess if they are oriented to meet small farmer needs. These should take account of the many non-technology factors that strategy-making processes confront (e.g. evidence shows that most "ultra poor" households live in remote areas not connected by roads. Many factors are important: the lack of credible baselines on the nature of food insecurity or poverty in many poor countries, including particularly of poor households, the many inappropriate or non-existent policies, institutions, infrastructure and finance to facilitate production in the small farm sector, the lack of capacity often to rely on international trade or indeed at times even local trade to meet needs of a poor farming households. Together these will influence the likelihood of success of even the best-designed research priorities.
4. At the national level in developing countries, there is a need to improve priority-setting processes with greater inputs from stakeholders, including the poor, civil society, private sector, academics in universities and think-tanks and representatives of small and marginal farmers and women, so as to reorient research, technology and knowledge systems.
5. At the regional level, there is a need to acknowledge the complexity of priority-setting given the importance of political considerations, sovereignty, cross-border competitiveness, and trade, particularly in setting priorities to address the needs and constraints of small and marginal farmers since typical research establishments do not represent their interests.
6. There is a need for the GFAR to have processes to advocate about gaps in under-investment in research generally and particularly those concerned with small farmers and to mobilize expertise to help improve strategies and the quality of partnerships.

7. GFAR should also strengthen its own methodologies for the regional consultation processes, using some universally-accepted standards of good practice across regions;

8. The CGIAR's Strategy and Research Framework and processes may need to be revisited to strengthen the more empirically based micro-economic foundations of its methodology to determine impacts on poor households rather than using macro measures of poverty or food insecurity, given the empirical weaknesses of those macro measures discussed earlier.

The challenge of reorienting research to small farmer needs cannot be resolved in a period of one to two years. However a start should be made now. The GAT proposes the following Road Map.

B. Continued work on the Road Map from GCARD 2010 to GCARD 2012

The Global Author Team (GAT) provided this draft version (below) of a Montpellier Action Plan, or Road Map, in their original paper submitted to GCARD 2010 conference attendees; in the concluding session of the conference, a revised version (based on conference discussions) was presented and debated by the audience. Since the conference, the GAT, in collaboration with conference participants and stakeholders, has continued to develop a revised Road Map that reflects the themes, issues, and goals outlined during GCARD 2010; the revised version has been submitted to GFAR and will undergo further developments before being issued. The greatest challenge is to operationalize the Road Map as soon as possible since GCARD 2012 is less than two years away and there is urgent need to report a few genuine triumphs at GCARD 2012. Several of the key changes between draft and revised versions are detailed below.

- the draft Road Map emphasized, 1) stakeholder commitment and partnerships and, 2) 'scaled-up' capacities for research and delivery; the revised version reinforces that while these two elements are necessary, *that most importantly, if AR4D is to achieve its goals, the outputs of the partnerships and revitalized research must be available to (and shaped by) small farmers.*
- the revised Road Map underlines the focus on developing-country needs as the starting point for AR4D - research pathways, milestones, and targets *must be defined by individual countries, within the context of their own national development plans.* The original draft centered on the priority-setting activities conducted by the regions pre-conference; the revised version broadens the scope and responsibility by saying that *a well-functioning AR4D system has 'national and regional development objectives as the driver and national systems and regional organizations as the foci, supported by international and regional actions as required.'*
- the revised Road Map acknowledges *synergies between regional research priorities and the CGIAR Research Programs (CRPs), and concludes that they provide a useful starting point for a global cooperative effort;* it proposes that the CGIAR SRF, the CRPs, and GCARD 2012 processes should be aligned and focused on establishing specific goals and developing the required sub-regional/regional/national inputs and capacities to deliver desired impacts around the proposed thematic areas.
- at the same time, the CG alone can not be responsible for driving national agricultural research. As was mentioned in the draft version, the revised Road Map reiterates *the responsibility of national research and innovation systems for increasing their capacity and 'filling the backlog of underinvestment'.* The revised version calls attention to the effect of *stalled-political commitment* in an effective AR4D system, which has resulted in gross under-investment in both national and regional research organizations.

- the revised version elaborates on the draft's assertion that *effective and comprehensive monitoring and reporting systems are needed to record developments and provide feedback on implementation.*
- lastly, the revised version lays out explicit actions and responsibilities for all stakeholders and actors, including specific financial estimates for increased investments.

The DRAFT Road Map

To transform the agricultural research for development system into a cohesive whole, urgent action is now needed on a variety of fronts.

Who Should Make the Commitment?

This roadmap sets out what is required in the form of collective action among stakeholders over the coming years. Its success will depend on individuals and institutions each to playing their part in delivering shared development goals.

The stakeholders who should commit are:

- National policy makers of developed and developing countries;
- All relevant stakeholders at the local, sub-national, national, regional and international levels engaged in and/or supporting agricultural research knowledge and information systems including the CGIAR, educational, research and extension institutions, and farmers organizations;
- Donors and other development assistance agencies, including bilateral and multilateral institutions and development banks;
- Private sector, including small, medium and large agricultural input companies, food companies, agricultural banks, insurers and the agribusiness sector;
- Civil society organizations at all levels, from sub-national to national and international;
- Representatives of the poor and women;
- Stewards of the environment.

Towards a Well-Functioning AR4D System

GAT's vision of a Transformed Agricultural Research for Development is set out in Box 2 (Chapter 2). The resulting reforms, assuming that they have a broad ownership of the stakeholders in the countries and regions where action is most needed, could have major positive impacts on the NARS' future capacities, incentives, and performance. The transformation should start with the implementation of priorities each region has set out for itself assuming they are broadly shared by stakeholders. Based on lessons learnt through implementation of some high priority programs regional organizations should improve and refine their processes over time. GFAR/GCARD and its constituent members also should agree on some minimum standards for partnerships in strategic areas of collaboration based on some of the principles outlined in chapter 5, defining the *combined* objectives of developing countries, the CGIAR and other partners, their relative comparative advantages, and the principles of subsidiarity, i.e. letting actors at the relevant levels take active responsibility for implementation of programs designed in pursuit of sustainable intensification by the poor, their expected outputs and impacts.

The current timeline for the final approval of the SRF and thematic areas (or mega-programs) and the inputs of the regions in that process clearly needs to be revisited after GCARD 2010.

GCARD 2010 is the first step in a series of GCARDs in support of the Road Map for a long-term (4 to 6 years) process. It needs to establish clear milestones to achieve alignment in global AR4D.

A well-functioning AR4D system could have the following ten characteristics:

1. Starting with priorities already established through regional consultations and sought to be implemented by Regional Organizations, taking early steps to help facilitate their implementation;
2. Helping to ensure focus on researchable technologies and/or their delivery to meet farmer constraints on technology adoption;
3. Helping to address constraints identified by Regional Organizations, e.g., human resource development, incentives for scientists, accountability and effectiveness of multiple partnerships.
4. Facilitating the rapid generation of innovations in support of the spread of knowledge and technologies to small holders and identification of improvements needed in the delivery of services to involve and reach the poor;
5. Promotes effective use of collective capacities by strengthening key relationships among research, development (extension, seed suppliers, the banking sector) and farmer actors;
6. Actively achieves increased investments in human, institutional and financial resources;
7. Promotes coordinated operational linkages among development actors aimed at monitorable development impacts;
8. Increasing mutual and equal accountability among all stakeholders;
9. Committing to action;
10. Achieving credible monitoring and evaluation and reporting on what has changed.

Role of the Global Forum on Agricultural Research (GFAR) and GCARDs

The Global Forum on Agricultural Research was established to be an open and inclusive platform for all those involved in agricultural research and its role in development. As recognized by the G8, GFAR is well-suited to serve as a platform and apex body. But both GFAR and its regional constituent bodies need to be strengthened, acquiring increased legitimacy through inclusiveness and endorsement by its constituents, financial resources, expertise and credibility based on its and their demonstrated track records. GFAR's governance includes members from developing and developed country institutions (NARS, private sector, civil society, CGIAR, farmers' organizations, bilateral and multi-lateral donors, and international organizations) and has the broad upstream and downstream reach to include institutions that play key operational roles.

With strengthening, together, they can play key roles in i) advocating for agricultural research (and hence agriculture) in development, ii) helping to improve capacity of NARS and SROs to catalyze actions among the necessary stakeholders to collectively transform agricultural research systems for greater development impact, and (iii) providing leadership at the global level.

GCARD 2010 provides a unique opportunity to set in motion the process of transforming agricultural research for development (TAR4D). A series of biennial GCARDS over the next several years can become the vehicles for initiating and promoting cycles of learning and change. GCARDs can take on a combination of advocacy, mobilization of finance for investments, and human and institutional capital development at the national, regional and international levels.

A global transformation of research for development cannot be achieved without the commitment to investments and necessary institutional changes. GFAR will need to work through its constituencies and other partners in the international community to strengthen the many existing partnerships by:

- Starting to implement regional priorities identified through regional consultations;
- Helping them to improve their accountability to their constituencies;
- Building the capacity of the NARS and regional organizations to implement their priorities, improve incentives;
- Mobilizing appropriate support for strengthening the national, sub-regional and regional research organizations to help carry out the pro poor, pro women and pro environment agenda;
- developing briefs (documents) for policy makers to highlight the current state of AR4D and the potential contributions of AR4D;
- Working with its constituent regional bodies to reflect the particular regional needs and establish a process to fully introduce AR4D into the agendas of the different political and economic regional bodies (e.g. G8, G20);
- Working with multi-lateral, regional and bilateral organizations and development banks to establish a common strategy for the improvement of the effectiveness of the global AR4D system.
- Lobbying, monitoring and reporting on increased investment commitments by both developing and developed countries including the added capacity for innovation generated in developing countries from the baseline year of 2010.

For this to take place GFAR structure should be strengthened with the appropriate technical capacities. Its constituent regional fora should also undergo an in-depth review so as to assure they can play their strategic and leadership role in terms of taking the global discussion to the regional level and effectively connecting NARS, policy-makers and local stakeholders to the GFAR process as well as the CGIAR reform process and future MPs.

New Ideas and Best Practices

New ideas and best practices are needed. GFAR constituencies should collectively undertake the development of best practices related to the improvement of the architecture of the global system and its component by focusing on the improvement of:

- a) AR4D implementation processes by assuring transparent accountability to stakeholders, including particularly the poor, results-based management, achieving full gender participation, and monitoring and evaluating of implementation efforts;
- b) the global AR4D architecture by effective partnership strategies, mechanisms to increase the spillover effects of multi-country investments and capacities, better harnessing the outcomes of the reformed CGIAR research system towards development impact, and more public-private partnerships (PPPs), and deployment of new products for the benefit of the small-scale and resource-poor;
- c) the content of AR4D by making better use of foresight methodologies, strategic planning that fosters the creation of new knowledge as well as the capacity to seek existing technologies, research priority-setting to focus on reducing the vulnerability of poor people, and ensuring a diversity of approaches that include combinations of traditional knowledge, conventional technologies, agro-ecological methods and modern biotechnology;

Exogenous Factors

The largely exogenous conditions for delivery include the need for secure land rights, revival of extension systems, engagement of CSOs, development of policy capacity, promotion of rural infrastructure and information technology, and establishment of appropriate financial institutions.

Monitoring and Reporting System for an Evolving TAR4D Global System

An effective transformation needs a process with clear reporting and accountability. This should be built on objective data on key indicators that enables (i) keeping track of changes and their results, and (ii) a transparent feedback to all concerned stakeholders about progress on the transformation strategy and its implementation.

GCARD should thus establish a monitoring and reporting system to track commitments and progress towards a more effective global AR4D system. This system should:

- Develop a baseline analysis of the state of the AR4D system, starting with 2010 as the base year and including all partners currently not included in the research and reporting;
- Track improvement in the capacities, incentives and management systems in which national and regional organizations seek reforms;
- Ensure countries are committed to developing the databases for their countries as tools for policy-making.
- Develop a transparent registry of actions, commitments and responsibilities by national and international actors;
- Support a permanent mechanism enabled under GFAR for the development of key indicators on investments and capacities in research, human resource development and institutional innovations in support of food security, poverty reduction and increased environmental sustainability;
- Ensure the wide dissemination of results to those concerned with AR4D at least every two years at successive GCARDs and to policy makers in the G8 and G20.

The Responsibilities of Individual Developing Countries

Developing countries including emerging economies should commit to:

- a) Taking leadership positions at their respective levels;
- b) Enhancing their own policies, institutions and investments in support of achieving better impacts on the poor;
- c) Fostering institutional innovations to transform their national and regional AR4D systems;
- d) Incorporating their strategic needs to support such transformation in strategies;
- e) Adopting an inclusive process involving all relevant stakeholders to develop strategies on what technologies and knowledge need to be generated or mobilized nationally and how to access new technologies and knowledge from external sources;
- f) Strengthening their SROs and ROs as instruments to foster regional cooperation, better use of available resources, and improved scientific infrastructures.

Industrialized Countries, Emerging Economies and Global and Regional Organizations

Industrialized countries, emerging economies and international organizations should commit to:

- a) Adopting explicit commitments to increase investment and human resource development to (i) meet MDGs or nationally-established goals for poverty reduction, food security and environmental sustainability, and ii) ensure that national and international efforts attain the required levels of investment;
- b) Supporting national efforts to build SROs and ROs to complement national efforts, particularly to support smaller countries, so as to achieve the necessary scale to effectively meet research needs and promote international standards and accountability in research management;

- c) Ensuring effective inclusion of research, extension and capacity development in rural development programs funded by governments and donors.

Concluding Comments

Agricultural research and development efforts that engage farmers and build from the bottom-up can release locked-up innovation, become responsive and effective, encourage many different pathways, and result in adequate food for all. Without investments in agricultural and overall economic and social development, research alone would be a blunt instrument in efforts to eradicate poverty and hunger.

References

Glossary of Terms

Annexes

- A. Analysis and Recommendations related to Partnerships in recent Reports, External Program and Management Reviews (EPMRs) and Challenge Programs External Reviews (CPEs)*
- B. Summary of Regional Priorities, as determined by the Regional Consultations*
- C. Illustrative Partnership Performance Indicators (from EMBRAPA's Agricultural Technology Development Program)*
- D. TORs of the Global Author Team*

NOTE: the above referenced documents are available as separate enclosures to this report.

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GLOSSARY OF TERMS¹

A

Absolute Advantage

An advantage that a country has in producing certain goods or services relative to all or many other countries due to specific factors of production at its disposal—such as rich farmland and a favorable climate for agricultural production or a highly educated labor force for high-tech manufacturing. A country's absolute advantage means that it can produce certain goods or services at a lower cost than would be possible for other countries. Thus it is clearly beneficial for this country to specialize in producing and exporting these goods and services. But even countries that do not have any absolute advantages can benefit from international trade; see *comparative advantage* (World Bank, 2004).

Access to Adequate Food

The right to adequate food is realized when every man, woman and child, alone or in community with others, has physical and economic access at all times to adequate food or means for its procurement (FAO, 2009c: 1).

Accountability

1) As a criterion for assessing governance and management, the extent to which accountability is defined, accepted, and exercised along the chain of command and control within a program, starting with the annual general meeting of the members or parties at the top and going down to the executive board, the chief executive officer, task team leaders, implementers, and in some cases, to the beneficiaries of the program (IEG, 2007: xxvii);
2) Accountability can be defined as the obligation of power-holders to account for or take responsibility for their actions. In the right

¹ This *Glossary of Terms* has been compiled from a variety of sources. It does not attempt to formulate absolute definitions; rather, it is meant to illustrate the diversity and variety of definitions and terms used within the development context, in the hopes that we can further refine our vocabulary and our understanding of commonly used development terms and concepts.

to food context, four main types of accountability mechanisms based on the nature of the forum are of particular relevance: political, administrative, legal and social (FAO, 2009c: 4).

Afforestation

Establishment of forest through planting and/or deliberate seeding on land that, until then, was not classified as forest. Implies a transformation of land use from non-forest to forest (FAO, 2009a: 1).

Agriculture

The sector of an economy that includes crop production, animal husbandry, hunting, fishing, and forestry (World Bank, 2004).

Agricultural Biodiversity

The component of biodiversity that is relevant to food and agriculture production. The term agro-biodiversity encompasses genetic species and ecosystem diversity. *Related Terms:* biological diversity; functional biodiversity; soil biodiversity (FAO, 2009b: 3).

(Global) Agricultural Research for Development (ARD) System

The universe of institutions and organizations that have a mandate to do research and related activities – including organization, management, and funding of research – with a clear objective of contributing to development (CGIAR, 2008: 74).

Agricultural Intensification

Refers to any practice that increases productivity per unit land area at some cost in labor or capital inputs. One important dimension of agricultural intensification is the length of fallow period (i.e. letting land lie uncultivated for a period) and whether the management approach uses ecological or technological means. *Related Terms:* ecological intensification; sustainable intensification; intensive agriculture (FAO, 2009b: 5).

Agrochemical

Agrochemicals are commercially produced, usually synthetic, chemical compounds used in farming such as a fertilizer, pesticide or soil conditioner (FAO, 2009b: 7).

Agroecology

Agro-ecology is the science and practice of applying ecological concepts and principles to the study, design and management of the ecological interactions within agricultural systems (e.g. relations between and among biotic and abiotic elements). This whole-systems approach to agriculture and food systems development is based on a wide variety of technologies, practices and innovations including local and traditional knowledge as well as modern science (FAO, 2009b: 8).

Agroecosystem

A semi-natural or modified natural system managed by humans for food and agricultural production purposes. *Related Terms:* ecosystem services; agro-ecological alternative; agro-ecological science; agro-ecology (FAO, 2009b: 4).

Agro-Energy

Energy derived from purposely-grown crops, and from agricultural and livestock by-products, residues and wastes (FAO, 2009a: 2).

Agroforestry

Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land management unit as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economic interactions between the different components (FAO, 2009b: 9).

Agrofuel

Biofuels derived from non-forest activities and obtained as a product of energy crops and/or agricultural by-products. It includes fuel crops, agricultural by-products, animal by-products, and agro-industrial byproducts (FAO, 2009a: 2).

B

Baseline

An analytical description of the situation prior to a development intervention, against which

progress can be assessed or comparisons made (IEG, 2007: xxvii).

Biodiversity

The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. *Related Terms:* functional biodiversity; agro-biodiversity; genetic diversity; species diversity; ecosystem diversity (FAO, 2009b: 14).

Biofuel

Fuel produced directly or indirectly from biomass such as fuelwood, charcoal, bioethanol, biodiesel, biogas (methane) or biohydrogen; any solid, liquid or gaseous fuel produced from biomass (FAO, 2009a: 11).

Biomass

The total mass of living organisms in a given area or of a given species usually expressed as dry weight. Organic matter consisting of, or recently derived from, living organisms (especially regarded as fuel) excluding peat. Biomass includes products, by-products and waste derived from such material. Cellulosic biomass is biomass from cellulose, the primary structural component of plants and trees (Metz et al., 2007).

Biofuel or Biomass Fuels

A fuel produced from dry organic matter or combustible oils produced by plants. These fuels are considered renewable as long as the vegetation producing them is maintained or replanted, such as firewood, alcohol fermented from sugar, and combustible oils extracted from soy beans. Their use in place of fossil fuels cuts greenhouse gas emissions because the plants that are the fuel sources capture carbon dioxide from the atmosphere (UNFCCC, 2010).

C

Carbon Footprint

The carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused

by an activity or is accumulated over the life stages of a product (FAO, 2009a: 19).

Catch Crop

A rapidly growing plant that can be intercropped between rows of the main crop; often used as a green manure (FAO, 2009b: 19).

Civil Society

Civil society refers to the arena of uncoerced collective action around shared interests, purposes and values. In theory, its institutional forms are distinct from those of the state, family and market, though in practice, the boundaries between state, civil society, family and market are often complex, blurred and negotiated. Civil society commonly embraces a diversity of spaces, actors and institutional forms, varying in their degree of formality, autonomy and power. Civil societies are often populated by organizations such as registered charities, development non-governmental organisations, community groups, women's organisations, faith-based organisations, professional associations, trade unions, self-help groups, social movements, business associations, coalitions and advocacy groups (FAO, 2009c: 9).

Climate Change

1) A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is, in addition to natural climate variability, observed over comparable time periods (FAO, 2009b: 22); 2) Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (Metz et al., 2007).

Climate Change Adaptation

1) Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (UNFCCC, 2010); 2) Initiatives and measures to reduce the vulnerability of natural and human systems

against actual or expected climate change effects. Various types of adaptation exist, e.g. anticipatory and reactive, private and public, and autonomous and planned. Examples are raising river or coastal dikes, the substitution of more temperature-shock resistant plants for sensitive ones, etc. (Metz et al., 2007).

Climate Change Mitigation

1) In the context of climate change, a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere (UNFCCC, 2010).

Collective Action Dilemma

The difficulty that rational, self-interested members of a group experience in achieving their common group interest, unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest (World Bank OED, 2003: 2).

Comparative Advantage

The ability of one economic actor to produce a good, service, or knowledge at a lower opportunity cost than another economic actor. Opportunity cost is the cost of forgoing one activity in favor of another, measured in terms of those goods, services, or knowledge whose production is forgone (World Bank OED, 2003: 2).

(Dynamic) Comparative Advantage

Dynamic comparative advantage describes how an economic actor may develop new comparative advantages over time as a result of new investments, learning by doing, or comparable changes experienced by other actors (World Bank OED, 2003: 2).

Compliance

Whether and to what extent countries do adhere to the provisions of an accord. Compliance depends on implementing policies ordered, and on whether measures follow up the policies. Compliance is the degree to which

the actors whose behaviour is targeted by the agreement, local government units, corporations, organizations or individuals, conform to the implementing obligations (Metz et al., 2007).

Conservation Agriculture

Conservation agriculture aims to achieve sustainable and profitable agriculture and subsequently aims at improved livelihoods of farmers through the application of the three CA principles: minimal soil disturbance, permanent soil cover and crop rotations. Conservation agriculture promotes no tillage to safeguard soil biodiversity, uses several organic fertilization practices such as rotations and mulching but allows the use of genetically modified organisms (GMOs) and chemical inputs, namely herbicides (FAO, 2009a: 14).

Contract Farming

A system where a central processing or exporting unit purchases the harvests of independent farmers and the terms of the purchase are arranged in advance through contracts. The terms of the contract vary and usually specify how much produce the contractor will buy and what price they will pay for it. The contractor frequently provides credit inputs and technical advice. Contracting is fundamentally a way of allocating risk between producer and contractor; the former takes the risk of production and the latter the risk of marketing. In practice, there is considerable interdependence between the two parties. The allocation of risk is specified in the contract which can vary widely; some agree to trade a certain volume of production; in others the contract specifies price (which can be market price, average price over a period of time, difference between a basic price and market price etc.) but not amount (FAO, 2009b: 28).

Conventional Agriculture

What is accepted as the norm and is the most dominant agricultural practice. Since World War II, (mainly in the industrialized world), conventional agriculture has become an industrialized form of farming characterized by mechanization, monocultures, and the use of synthetic inputs such as chemical fertilizers, pesticides and genetically modified organisms (GMOs), with an emphasis on maximizing

productivity and profitability and treating the farm produce as a commodity. In large parts of the developing world, agriculture is still "traditional", ranging from well-managed polycultures to extensive and eroding pastures. *Related Terms:* industrial agriculture; traditional agriculture; conservation agriculture (FAO, 2009b: 29).

Core Competence

An economic actor's unique set of assets that cannot be replicated easily by other actors. These are typically specific production resources, technological and managerial capabilities, or reputational integrity that help actors gain an advantage over competitors (World Bank OED, 2003: 2).

Cost-Benefit Analysis

Monetary measurement of all negative and positive impacts associated with a given action. Costs and benefits are compared in terms of their difference and/or ratio as an indicator of how a given investment or other policy effort pays off seen from the society's point of view (Metz et al., 2007).

Cost-Effectiveness

The extent to which the program has achieved or is expected to achieve its results at a lower cost compared with alternatives (IEG, 2007: xxvii).

Cost-Effectiveness Analysis

A special case of cost-benefit analysis in which all the costs of a portfolio of projects are assessed in relation to a fixed policy goal. The policy goal in this case represents the benefits of the projects and all the other impacts are measured as costs or as negative costs (co-benefits) (Metz et al., 2007).

D

De-commodification

De-commodification as a concept comes from the idea that in a market economy, traded goods and labour are commodities. De-commodification is the process of viewing utilities as an entitlement and food as carrier of

life and socio-cultural values, rather than as a monetized product (FAO, 2009b: 33).

Deforestation

The conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum 10 percent threshold. (FAO, 2009a: 26).

Dependency on Food Imports

The food import dependency is the percentage of available calories that are imported for human consumption. Dependency on food imports leads to numerous difficulties: increased debt and compounding of balance of payment problems; fluctuating external market prices for developing countries, which face a sharp reduction of their import capacity; and increased energy consumption in food transportation. The problems of dependency on food import and aid include political conditionality, vulnerability to a failure of delivery mechanisms, disincentive to local producers due to decreased food prices, competition with local traditional foods and changed consumption patterns (FAO, 2009b: 34).

Deregulation

An act by which the government regulation of a particular industry is reduced or eliminated in order to create and foster a more efficient marketplace. Deregulation is usually enacted to weaken government influence and forge greater competition. By this token, deregulation also creates an economic environment favorable to upstart companies that were unable to enter the industry prior to the passing of deregulation. It is also widely held that deregulation often serves as a catalyst for increased innovation and mergers among weaker competitors. Deregulation is often driven by lobbyists and lobbying groups that represent various industries and business interests. Industries that have undergone deregulation include communications, banking, securities, transportation, as well as power and utility. Although deregulation might purge government influence all together, some government oversight usually remains (FAO, 2009c: 13).

Desertification

Land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities. The United Nations Convention to Combat Desertification defines land degradation as a reduction or loss, in arid, semi-arid, and dry sub-humid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as soil erosion caused by wind and/or water, deterioration of the physical, chemical and biological or economic properties of soil and long-term loss of natural vegetation (Metz et al., 2007).

Developed Countries

(Also known as Industrialized Countries, Industrially Advanced Countries) High-income countries, in which most people have a high standard of living. Sometimes also defined as countries with a large stock of physical capital, in which most people undertake highly specialized activities. Depending on who defines them, developed countries may also include middle-income countries with transition economies, because these countries are highly industrialized. They are also sometimes referred to as "the North" (World Bank, 2004).

Developing Countries

According to the World Bank classification, countries with low or middle levels of GNP per capita. Several countries with transition economies are sometimes grouped with developing countries based on their low or middle levels of per capita income, and sometimes with developed countries based on their high industrialization (World Bank, 2004).

Development

An economic, social, cultural and political process, aiming at the constant improvement of the wellbeing of all individuals (FAO, 2009c: 13).

Devolution, or Exit Strategy

A proactive strategy to change the design of a program, to devolve some of its implementation responsibilities, to reduce dependency on external funding, or to phase out the program

on the grounds that it has achieved its objectives or that its current design is no longer the best way to sustain the results which the program has achieved (IEG, 2007: xxvii).

Disaster Risk Management

The systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of nature hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards (FAO, 2009a: 28).

Donor

Any organization or entity that makes a financial or in-kind contribution to a program that is reflected in the audited financial statements of the program. Thus, the term includes not only "official donors" but also developing countries that contribute annual membership dues, seconded staff, or office space, provided that these are formally recognized, as they should be, in the financial statements of the program. Donors can also be beneficiaries, especially in the case of programs that provide global public goods of direct or tangential benefit to both developed and developing countries (IEG, 2007: xvii).

E

Ecological Agriculture

A management system that enhances natural regenerative processes and stabilizes interactions within local agro-ecosystems. Ecological agriculture includes organic agriculture as well as other ecological approaches to farming that allow the use of synthetic inputs. *Related Terms:* organic agriculture; agro-ecology; permaculture; environmentally friendly agriculture; sustainable agriculture; ecology principle (FAO, 2009b: 38).

Economic Development

Qualitative change and restructuring in a country's economy in connection with

technological and social progress. The main indicator of economic development is increasing GNP per capita (or GDP per capita), reflecting an increase in the economic productivity and average material wellbeing of a country's population. Economic development is closely linked with economic growth (World Bank, 2004).

Economic Efficiency

The economic efficiency of an agricultural system is determined by yield, product prices and production costs (FAO, 2009b: 42).

Economic Growth

Quantitative change or expansion in a country's economy. Economic growth is conventionally measured as the percentage increase in gross domestic product (GDP) or gross national product (GNP) during one year. Economic growth comes in two forms: an economy can either grow "extensively" by using more resources (such as physical, human, or natural capital) or "intensively" by using the same amount of resources more efficiently (productively). When economic growth is achieved by using more labor, it does not result in per capita income growth. But when economic growth is achieved through more productive use of all resources, including labor, it results in higher per capita income and improvement in people's average standard of living. Intensive economic growth requires economic development (World Bank, 2004).

Ecosphere

The surface zone of the Earth and its adjacent atmosphere in which all living organisms exist in interaction with other living organisms and their non-living environment (temperature, water, light, oxygen, carbon dioxide, and so on). Humans' survival as biological species depends on ecological "services"—such as climate stabilization or pollution absorption (World Bank, 2004).

Ecosystem

A system of living organisms interacting with each other and their physical environment. The boundaries of what could be called an ecosystem are somewhat arbitrary, depending on the focus of interest or study. Thus, the extent of an ecosystem may range from very

small spatial scales to the entire planet Earth ultimately (Metz et al., 2007).

Ecosystem Approach

A strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way. It is based on the application of appropriate scientific methodologies focused on levels of biological organization which encompass the essential processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of ecosystems (FAO, 2009b: 42).

Effectiveness or Efficacy

The extent to which the program has achieved, or is expected to achieve, its objectives, taking into account their relative importance (IEG, 2007: xxviii).

Effective Financing

Effective financing is defined as one that increases the average returns of current levels of investment in agricultural research (efficiency criteria) and that also attracts complementary investment from additional sources (market) (Echeverria and Beintema, 2009: 17).

Efficiency

1) (In an programmatic context) The extent to which the program has converted or is expected to convert its resources/inputs (such as funds, expertise, time, etc.) economically into results in order to achieve the maximum possible outputs, outcomes, and impacts with the minimum possible inputs (IEG, 2007: xxviii); 2) (In an agricultural context) The ratio of a system's output (or production) to the inputs that it requires, as in the useful energy produced by a system compared with the energy put into that system. In ecology, efficiency is the percentage of useful energy transferred from one trophic level to the next (such as the ratio of production of herbivores to that of primary producers). Used in the context of production, efficiency is the ratio of useful work performed to the total energy expended, thus it does not count any wastage that is generated. In the context of the allocation of resources, efficiency is the condition that would make at least one person

better off and no one worse off (FAO, 2009b: 45).

Empowerment

1) Empowerment takes place when people, especially poor people, are enabled to take more control over their lives, and secure a better livelihood with ownership and control of productive assets as a key element. The individual's capacity to make effective choices is conditioned by: (i) ability to make meaningful choices, recognising the existence of options, and (ii) the opportunities that exist in the person's formal and informal environment (FAO, 2009b: 45); 2) The human rights principle of empowerment means that people should have the power, capacities, capabilities and access needed to change their own lives, including the power to seek from the state remedial actions for violations of their human rights (FAO, 2009c: 18).

Environmental Sustainability

Forms of progress that meet the needs of the present generations of natural resources capital and environmental services without compromising the ability of future generations to meet their needs. *Related Terms:* sustainable use of natural resources; sustainable development (FAO, 2009b: 49).

Equity

Term used for the administration of justice according to principles of fairness and conscience. The term includes both intra-generational and inter-generational equity. Intra-generational equity is the principle by which all sections of the community share equitably in the costs and benefits of achieving sustainable development. Inter-generational equity is the principle by which each generation utilizes and conserves the stock of natural resources (in terms of diversity and carrying capacity) in a manner that does not compromise their use by future generations (FAO, 2009b: 50).

Evaluation

1) The systematic and objective assessment of an ongoing or completed policy, program, or project, its design, implementation, and results. The aim is to determine the relevance and achievement of its objectives, and its

developmental effectiveness, efficiency, impact, and sustainability (IEG, 2007: xxviii); 2) An evaluation involves a systematic and balanced analysis of completed, ongoing or future activities, their design, implementation and results. The aim is to determine the fulfilment of objectives, resource efficiency, developmental effectiveness, and the impact that the fulfilment of objectives has on the overall human rights goal of the project, and its sustainability (FAO, 2009c: 19).

Experimental Farm

An innovative solution approach for the development of alternative (such as organic) farming through farmer involvement in research. The farmer, or group of farmers, should for the most part be able to independently identify and address agricultural problems through on-farm experiments which are self-designed and implemented. Of special emphasis is that on-farm experiments are incorporated into practical operations, applying the farmer's own equipment (FAO, 2009b: 52).

Extension System

Extension service refers to those entities in the country responsible for the transfer of information, technology and advice regarding the improvement of agricultural practices, including production, handling, storage and marketing of agricultural commodities (FAO, 2009b: 53).

F

Fairness

As a criterion for assessing governance and management, the extent to which partners and participants, similarly situated, have equal opportunity to influence the program and to receive benefits from the program (IEG, 2007: xxviii).

Farmer Field-School

A form of adult education, which evolved from the concept that farmers learn optimally from field observation and experimentation. It was developed to help farmers tailor their integrated pest management (IPM) practices to diverse and dynamic ecological conditions. FFS is a group-

based learning process that brings together concepts and methods from agro-ecology, experiential education and community development. *Related Terms:* farmer life school (FLS); farm school; farmer-scientist partnership; farmers' organization; farmer- to- farmer training; experimental farm (FAO, 2009b: 58).

Farmer Association/ Organization

The terms "agricultural producers' associations" and "farmers' associations" are often used interchangeably. Agricultural producers and farmers include small, medium and large farmers, family farmers, landless peasants, subsistence farmers, tenant farmers, sharecroppers and indigenous and other people who work the land. The term "agricultural producers" is often used in the broad sense to include fishers and foresters. The International Federation of Agricultural Producers (IFAP) describes its member associations as "organizations owned and governed by farmers which work for farmers' interests. They are organizations by farmers for farmers. These include farmers' unions, agricultural cooperatives and chambers of agriculture. Regular election of officers is critical to the credibility and authenticity of representative farmers' organizations." *Related Terms:* farmer-led research and training; farmer-scientist partnership; farmer-to-farmer training (FAO, 2009b: 59).

Farmer Participatory Research

A farmer-scientist partnership seeks to develop and test agricultural technologies through farmers. This approach encompasses diverse research and research-related activities that range from informal surveys with a few farmers, to conducting research with farmer involvement, to community empowerment, technology development and dissemination by extension services and other development institutions. Also called farmer participatory research, this approach is based on dialogue between farmers and researchers in order to develop improved technologies that are practical, effective, profitable, and will solve identified agricultural production constraints (FAO, 2009b: 59).

Farmer-to-Farmer Training

Exchange of knowledge and experience among farmers. While a Farmer Field School is organized around a facilitator or a farmer-trainer supported by a project, farmer-to-farmer training is a looser concept that includes also ad hoc visits between farmers and visits of farmers to demonstration farms (FAO, 2009b: 60).

Food Access, Access to Food (Right to Food)

1) Access by individuals to adequate resources (entitlements) for producing or acquiring appropriate foods for a nutritious diet. Entitlements are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economics and social arrangements of the community in which they live (including traditional rights such as access to common resources) (FAO, 2009b: 62). 2) In the context of human right to food, accessibility of food entails both economic and physical accessibility: Economic accessibility implies that personal or household financial means to buy food for an adequate diet should be at a level to ensure that satisfaction of other basic needs are not threatened or compromised. Economic accessibility applies to any acquisition pattern or entitlement through which people procure their food. Physical accessibility implies that adequate food is accessible to everyone, including vulnerable individuals and groups such as infants, small children, elderly people, the physically disabled, people terminally ill or with persistent medical - including mental - problems, and prisoners. Victims of natural or human-made disasters, armed conflicts and wars, indigenous peoples and ethnic groups, people in remote areas and other disadvantaged groups may need special attention with respect to accessibility of food (FAO, 2009c: 2).

Food Aid

Food aid is a transaction by which food commodities destined to human consumption are provided to a recipient country, a group of people or a beneficiary entity either on a fully grant form or on a concessional loan basis. Such transactions include donations made by governments, supra-governmental organisations, intergovernmental organisations, non-governmental organisations, private companies, foundations and private individuals. One distinguishes food aid that is funded from

external sources, most of the time within the framework of public assistance schemes (including both development assistance and humanitarian aid) from food assistance which is financed from internal sources and is provided either by the government of the recipient country or by non-governmental organisations (FAO, 2009c: 21).

Food Availability, Availability of Food

In the context of human right to food, availability refers to availability of food of a quantity and quality sufficient to satisfy the dietary needs of individuals, free from adverse substances, and acceptable within a given culture, supplied through domestic production or imports (FAO, 2009c: 7).

Food Insecurity

A situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level. Food insecurity, poor conditions of health and sanitation, and inappropriate care and feeding practices are the major causes of poor nutritional status. Food insecurity may be chronic, seasonal or transitory (FAO, 2009c: 22).

Food Poverty

Food poverty, as measured by FAO, is less restrictive with a cut-off cost of a food basket corresponding to the average dietary energy requirement (ADER) that is the energy required to maintain a healthy life while performing a moderate level of physical activity (FAO, 2009c: 24).

Food Security

Food security takes place when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). The multidimensional nature of food security includes food availability, access, stability and utilization (FAO, 2009b: 63).

Food Self-Reliance

The capacity to generate enough income through farming and off-farm activities in order to meet food needs. While some food may be directly consumed, cash crops allow purchasing what cannot be locally produced. Food self-reliance means more than having the capacity to grow food in-country or on-farm. It also means having the economic capacity and capital to purchase food that cannot be grown domestically (FAO, 2009b: 63).

Food Sovereignty

According to the Nyéléni Declaration on Food Sovereignty, food sovereignty includes: 1) prioritizing local agricultural production in order to feed the people, access of peasants and landless people to land, water, seeds, and credit. Hence the need for land reforms, for fighting against GMOs (Genetically Modified Organisms), for free access to seeds, and for safeguarding water as a public good to be sustainably distributed. 2) the right of farmers, peasants to produce food and the right of consumers to be able to decide what they consume, and how and by whom it is produced. 3) the right of Countries to protect themselves from too low priced agricultural and food imports. 4) agricultural prices linked to production costs: they can be achieved if the countries or unions of states are entitled to impose taxes on excessively cheap imports, if they commit themselves in favour of a sustainable farm production, and if they control production on the inner market so as to avoid structural surpluses. 5) the populations taking part in the agricultural policy choices. 6) the recognition of women farmers' rights, who play a major role in agricultural production and in food (FAO, 2009c: 26).

Food Vulnerability

The full range of factors that place people at risk of becoming food insecure. These can be external or internal. External factors include: trends such as depletion of natural resources from which the population makes its living; environmental degradation or food price inflation; shocks such as natural disasters and conflict; and seasonality, such as seasonal changes in food production and food prices. Internal factors that determine the capacity of people to cope with difficulties include the characteristics of people themselves; the

general conditions in which they live and the dynamics of their households. The degree of vulnerability of individuals, households or groups of people is determined by their exposure to the risk factors and their ability to cope with or withstand stressful situations (FAO, 2009c: 27).

Foreign Direct Investment

Foreign investment that establishes a lasting interest in or effective management control over an enterprise. Foreign direct investment can include buying shares of an enterprise in another country, reinvesting earnings of a foreign-owned enterprise in the country where it is located, and parent firms extending loans to their foreign affiliates. International Monetary Fund (IMF) guidelines consider an investment to be a foreign direct investment if it accounts for at least 10 percent of the foreign firm's voting stock of shares. However, many countries set a higher threshold because 10 percent is often not enough to establish effective management control of a company or demonstrate an investor's lasting interest (World Bank, 2004).

Forest

Defined under the Kyoto Protocol as a minimum area of land of 0.05-1.0 ha with tree-crown cover (or equivalent stocking level) of more than 10-30 % with trees with the potential to reach a minimum height of 2-5 m at maturity in situ. A forest may consist either of closed forest formations where trees of various storey and undergrowth cover a high proportion of the ground or of open forest. Young natural stands and all plantations that have yet to reach a crown density of 10-30 % or tree height of 2-5 m are included under forest, as are areas normally forming part of the forest area that are temporarily un-stocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest (Metz et al., 2007).

Forest Degradation

Forest degradation is the reduction of the capacity of a forest to produce goods and services. The term 'capacity' refers to the time scale and the reference state of any given forest. Although this core definition is not considered to serve as a substitute for existing

definitions, it is offered to clarify the common ground between them (FAO, 2009a: 35).

Free Trade

International trade, which is neither restricted nor encouraged by direct government intervention. In principle, economists consider free trade to be desirable for maximizing overall economic efficiency. However in reality international trade is usually heavily influenced by import tariffs, import quotas, and export subsidies. Free-trade agreements between two countries and free-trade areas including several countries are often used to remove or reduce such tariff and non-tariff barriers to trade (World Bank, 2004).

Fuel wood

Wood in the rough (such as chips, sawdust and pellets) used for energy generation (FAO, 2009a: 36).

G

Genetically Modified Organism (GMO)

An organism in which the genetic material has been changed through modern biotechnology in a way that does not occur naturally by multiplication and/or natural recombination. For instance, a plant may be given fish genetic material that increases its resistance to frost. Another example would be an animal that has been modified with genes that give it the ability to secrete a human protein (FAO, 2009b: 66).

Global Warming/Greenhouse Effect

The progressive gradual rise of the earth's surface temperature thought to be caused by the anthropogenic greenhouse effect and responsible for changes in global climate patterns. The greenhouse effect corresponds indeed to a warming process of the earth's atmosphere caused by a build-up of carbon dioxide and other greenhouse or trace gases that act like a pane of glass in a greenhouse, allowing sunlight to pass through and heat the earth but preventing a counterbalancing loss of heat radiation (FAO, 2009a: 38).

Global and Regional Partnership Program (GRPP)

Programmatic partnerships in which: 1) The partners contribute and pool resources (financial, technical, staff, and reputational) toward achieving agreed-upon objectives over time; 2) The activities of the program are global, regional, or multi-country (not single-country) in scope; 3) The partners establish a new organization with a governance structure and management unit to deliver these activities (IEG, 2007: xvi).

Governance

(In a programmatic context) The structures, functions, processes, and organizational traditions that have been put in place within the context of a program's authorizing environment to ensure that the program is run in such a way that it achieves its objectives in an effective and transparent manner. It is the framework of accountability and responsibility to users, stakeholders and the wider community, within which organizations take decisions, and lead and control their functions, to achieve their objectives (IEG, 2007: xxviii).

Greenhouse Gases (GHGs)

Gases released by human activity that are responsible for climate change and global warming. The six gases listed in Annex A of the Kyoto Protocol are carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), as well as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆) (World Bank Carbon Finance Unit, 2010).

Gross Domestic Product (GDP)

The value of all final goods and services produced in a country in one year (see also gross national product). GDP can be measured by adding up all of an economy's incomes- wages, interest, profits, and rents- or expenditures- consumption, investment, government purchases, and net exports (exports minus imports). Both results should be the same because one person's expenditure is always another person's income, so the sum of all incomes must equal the sum of all expenditures (World Bank, 2004).

Gross National Product (GNP)

The value of all final goods and services produced in a country in one year (gross domestic product) plus income that residents

have received from abroad, minus income claimed by non-residents. GNP may be much less than GDP if much of the income from a country's production flows to foreign persons or firms. But if the people or firms of a country hold large amounts of the stocks and bonds of firms or governments of other countries, and receive income from them, GNP may be greater than GDP. For most countries, however, these statistical indicators differ insignificantly. "Gross" indicates that the value lost through the "wear and tear" of capital used in production is not deducted from the value of total output. If it were deducted, we would have a measure called net domestic product (NDP), also known as national income. The words "product" and "income" are often used interchangeably, so GNP per capita is also called income per capita (World Bank, 2004).

H

High External Input Agriculture (HEIA)

Intensive use of external non renewable resources (fertilizers, pesticides, fossil fuels) generally associated with cash crop production. HEIA farming systems are associated with the Green Revolution and are found mainly in ecologically "high potential" areas in the tropics and are most widespread in Asia (FAO, 2009b: 71).

Human Capital

People's innate abilities and talents plus their knowledge, skills, and experience that make them economically productive. Human capital can be increased by investing in health care, education, and job training (World Bank, 2004).

Human Development Index (HDI)

Composite of several social indicators that is useful for broad cross-country comparisons even though it yields little specific information about each country. First used in the United Nations Development Programme's Human Development Report 1990 (World Bank, 2004).

Human Resources

The total quantity and quality of human effort available to produce goods and services. The muscle power and brain power of human

beings. Human resources can be viewed as consisting of raw labor- determined mostly by the number of people in a country's labor force- combined with human capital (World Bank, 2004).

Hunger

No internationally recognized legal definition of hunger exists. However, it is today widely accepted that it goes beyond a minimum calorific package sufficient to prevent death by starvation. [The term 'starvation' refers to the most extreme form of hunger; death by starvation is the end result of a chronic, long-lasting and severe period of hunger; it is ultimate evidence of protracted right to food violation.] The concept of hunger is commonly used for situations of serious food deprivation as well as for different forms of undernutrition, including a shortfall in access to sufficient food or in essential components of nutritionally necessary food making an impact on the normal physical or mental capacity of the person, or group of persons. Independent of any formal definition, it is clear that hunger negatively affects people's health, productivity and overall well-being and has detrimental effects on children leading to stunted growth, decreased physical and mental capacities, hindering foetal development and contributing to mental retardation (FAO, 2009c: 36).

I

Impact(s), Outcome(s)

1) Positive and negative, primary and secondary long-term effects produced by a development intervention, directly or indirectly, intended or unintended (IEG, 2007: xxiv). 2) The observable results that activities and inputs will have on the real world. Specifically, outcomes refer to short-term consequences resulting from the direct use of the research outputs or from the research process itself, while impact refers to longer term effects resulting directly and indirectly, completely or partially from the research outputs that are implemented and from the consequences of the research process itself (CGIAR, 2008: 74).

Indicator(s)

A quantitative or qualitative factor or variable that provides a simple and reliable means to measure achievement, to reflect the changes connected to an intervention, or to help assess the performance of a development actor (IEG, 2007: xxiv).

Industrial Agriculture

A form of modern farming that refers to the industrialized production of livestock, poultry, fish, and crops. The methods of industrial agriculture are techno-scientific, economic and political. They include innovation in agricultural machinery and farming methods, genetic technology, techniques for achieving economies of scale in production, the creation of new markets for consumption, the application of patent protection to genetic information, and global trade. These methods are widespread in developed nations and increasingly prevalent worldwide. *Related Terms:* intensive farming; corporate agriculture; conventional agriculture; factory farming (FAO, 2009b: 74).

Industrialization

The phase of a country's economic development in which industry grows faster than agriculture and gradually comes to play the leading role in the economy (World Bank, 2004).

Industry

The sector of an economy that includes mining, construction, manufacturing, electricity, gas, and water (World Bank, 2004).

Input(s)

The financial, human, and material resources used for a development intervention (IEG, 2007: xxiv).

Institution

A structure of social order governing the behaviour of a set of individuals and that shape human interactions by serving collectively valued goals. The term includes formal institutions (e.g. public institutions, nongovernmental and private organizations, training and educational institutions such as universities and research institutes) and informal institutions (e.g. village committees, community groups, farmer groups) (FAO, 2009b: 76).

Integrated Assessment

A method of analysis that combines results and models from the physical, biological, economic and social sciences, and the interactions between these components in a consistent framework to evaluate the status and the consequences of environmental change and the policy responses to it (Metz et al., 2007).

Intergovernmental Organization (IGO)

Organizations constituted of governments. Examples include the World Bank, the Organization of Economic Co-operation and Development (OECD), the intergovernmental Panel on Climate Change (IPCC), and other UN and regional organizations (Metz et al., 2007).

J

K

Knowledge Intensive Farming

Knowledge-intensive farming systems, such as organic agriculture replace external inputs with farmer's knowledge and thus require a greatly improved availability of ecological information to farmers, as well as support services concerned with new technologies and market information (FAO, 2009b: 81).

L

Land Degradation

UNCCD defines land degradation as a "reduction or loss, in arid, semi-arid, and dry sub-humid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest, and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical, and biological or economic properties of soil; and (iii) long-term loss of natural vegetation." (FAO, 2009a: 41).

Land Tenure, Security of Land Tenure

Tenure is the relationship among people, as individuals and groups, with respect to land and other natural resources. This relationship may be defined by written law or by custom. Tenure is an institution, i.e. rules invented by societies to regulate behaviour. The rules of tenure define how rights to land are to be assigned within societies. They define how access is granted to rights to use, control and transfer land, as well as associated responsibilities and restraints. In simple terms, land tenure systems determine who can use what resources of the land for how long, and under what conditions. Security of tenure (secure tenure, tenure security) is the certainty that a person's rights to land will be protected. People with insecure tenure face the risk that their rights to land will be threatened by competing claims, and even lost as a result of eviction. Security of tenure cannot be measured directly and, to a large extent, it is what people perceive it to be. The attributes of tenure security may change from one context to another. For example, a person may have a right to use a parcel of land for a six month growing season, and if that person is safe from eviction during the season, the tenure is secure. Tenure security can also relate to the length of tenure, in the context of the time needed to recover the cost of investment. Thus the person with use rights for six months will not plant trees, invest in irrigation works or take measures to prevent soil erosion as the time is too short for that person to benefit from the investment. The tenure is insecure for long-term investments even if it is secure for short-term ones (FAO, 2009b: 83).

Land-use

The total of arrangements, activities and inputs undertaken in a certain land-cover type (a set of human actions). The social and economic purposes for which land is managed (e.g., grazing, timber extraction, and conservation). Land-use change occurs when, e.g., forest is converted to agricultural land or to urban areas (Metz et al., 2007).

Least Developed Countries

Low-income countries where, according to the United Nations, economic growth faces long-term impediments - such as structural

weaknesses and low human resources development. A category used to guide donors and countries in allocating foreign assistance (World Bank, 2004).

Livelihood Security

The adequate and sustainable access to and control over resources, both material and social, to enable households to achieve their livelihood needs (e.g. income, food) (FAO, 2009b: 87).

Lock-in Effect

Technologies that cover large market shares continue to be used due to factors such as sunk investment costs, related infrastructure development, use of complementary technologies and associated social and institutional habits and structures (Metz et al, 2007).

Logical Framework, Logframe

A management technique that is used to develop the overall design of a program or project, to improve implementation monitoring, and to strengthen evaluation, by presenting the essential elements of the program or project clearly and succinctly throughout its cycle. It is a "cause and effect" model which aims to establish clear objectives and strategies based on a results chain, to build commitment and ownership among the stakeholders during the preparation of the program or project, and to relate the program's or project's interventions to their intended outcomes and impacts for beneficiaries (IEG, 2007: xxix).

Low External Input Agriculture (LEIA)

Use of the locally available, renewable resources, with very few or no external inputs, generally for subsistence only. Low input agriculture includes organic agriculture but also traditional systems where resources are exploited without active management to replenish them (e.g. soil nutrient mining). Inputs that are included in this definition include, but are not limited to labour, capital, fuel and fertilizer. Intentional low input farming systems seek to optimize the management and use of internal production inputs (i.e., on-farm resources) and to minimize the use of external production inputs (i.e., off-farm resources), such as purchased fertilizers and pesticides, wherever and whenever feasible and practicable, to lower

production costs, to avoid pollution of surface and groundwater, to reduce pesticide residues in food, to reduce a farmer's overall risk, and to increase both short and long term farm profitability. About one quarter of the world's population depends on LEIA farming system, mainly in ecologically "low potential" areas, in terms of area it is most widespread in sub-Saharan Africa (FAO, 2009b: 88).

M

Malnutrition

Malnutrition essentially means "bad nourishment". It encompasses overnutrition as well as undernutrition (see – Undernutrition). It concerns not only the quantity and quality of food (not having enough food, having too much food or the wrong types of food), but also the body's response to a wide range of infections that result in mal-absorption of nutrients or the inability to use nutrients properly to maintain health. People are malnourished if they are unable to utilize fully the food they eat, for example due to diarrhoea or other illnesses (secondary malnutrition), if they consume too many calories (overnutrition), or if their diet does not provide adequate calories and protein for growth and maintenance (undernutrition or protein-energy malnutrition). Malnutrition in all its forms increases the risk of disease and early death (FAO, 2009c: 47).

Market Failure

Cases when a market economy fails to provide people with a desirable supply of certain kinds of goods and services. Market failures can occur in a market economy when it does not produce enough public goods and goods with positive externalities, when it produces too many goods with negative externalities, when goods are overpriced by natural monopolies, and when market agents do not have access to sufficient information, such as information about the quality of some consumer goods. These market failures usually justify economic intervention by the government. But there is always the risk of government failure- in which faulty political processes or institutional structures prevent government measures from improving social welfare (World Bank, 2004).

Market Liberalization

Removing and abstaining from using state controls that impede the normal functioning of a market economy- for example, lifting price and wage controls and import quotas or lowering taxes and import tariffs. Market liberalization usually does not mean that a government completely abstains from interfering with market processes (World Bank, 2004).

Monitoring

The continuous assessment of progress achieved during program implementation in order to track compliance with a plan, to identify reasons for noncompliance, and to take necessary actions to improve performance. Monitoring is usually the responsibility of program management and operational staff (IEG, 2007: xxix).

Monocropping, Monoculture

Monocropping refers to specialized cultivation of one crop on a farm (often large plantations) and planting the same crop year after year, without rotation or follows. While monocropping is economically efficient in capital intensive enterprises, specialization leads to increased use of synthetic inputs to keep pest and diseases under check and fertilize the soil. Besides the high risk of crop failure in monocultivations, environmental externalities pose serious problems to the sustainability of natural resources and public health (FAO, 2009b: 90).

N

Natural Resources

Any portion of the natural environment, such as air, water, soil, botanical and zoological resources and minerals. A renewable resource can potentially last indefinitely (provided stocks are not overexploited) without reducing the available supply because it is replaced through natural processes (either because it recycles rapidly, as water does, or because it is alive and can propagate itself or be propagated, as organisms and ecosystems do). Non-renewable resources (such as coal and oil) may eventually

be replaced by natural processes, but these processes occur over long periods of geologic time rather than within the time-frame of current generations, and their consumption necessarily involves their depletion (FAO, 2009b: 93).

Non-governmental Organization (NGO)

Organizations that are not part of a governmental structure. They include environmental groups, research institutions, business groups, and associations of urban and local governments (UNFCCC, 2010).

Nutrition Insecurity

Nutrition insecurity can be either chronic (at all or at most times), seasonal or transitory. Persons can be nutritionally insecure due to food insecurity, or due to nonfood causes, such as poor health and sanitation conditions that result in certain diseases that affect the absorption of food by the body. Ensuring nutrition security means ensuring the enjoyment of the right to adequate food and of the right to health (FAO, 2009c: 52).

Nutrition Security

Nutrition security means not only that people consume enough calories and nutrients, but that their diet is well-balanced and of good quality. To use nutrients efficiently, a person must be well cared for and relatively free of disease. Nutrition security thus depends among other, on food security, disease prevention and control, health care, and adequate provision of care at individual, household and community levels (FAO, 2009c: 53).

O

Organic Agriculture

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, cultural, biological and mechanical methods, as

opposed to using synthetic materials, to fulfil any specific function within the system (FAO, 2009b: 99).

Output(s)

The products, capital goods and services that result from a development intervention. This may also include changes resulting from the intervention that are relevant to the achievement of outcomes (IEG, 2007: xxiv).

(Research) Output(s)

Specific products of research, such as new knowledge on various types of phenomena (physical, biological, social, economic, etc.) that are directly or indirectly linked with agricultural activities, technologies, improved processes, new organizational systems, institutions, etc. (CGIAR, 2008: 74).

Overnourishment

Overnourishment means a daily energy intake that consistently exceeds energy requirements, leading to people being overweight or obese. Obesity is associated with risk of chronic diseases, such as high blood pressure, diabetes, etc. Children and adults, whose body weight significantly exceeds their normal weight for an extended period, are thus overnourished. Dietary energy requirements of an individual are determined by the energy needs for normal body functions, and by energy needs to maintain good health and normal activity levels. Dietary energy requirements vary with age, gender and life style. They also vary between individuals of the same age and gender, as life styles and activity levels vary. At the same time, as life styles and activity levels change over time for the same person, so do her/his daily energy requirements, including for short periods of time, such as in seasonal agricultural labour (FAO, 2009c: 60).

P

Participant(s)

Stakeholders who are involved in the implementation of the program (including the final beneficiaries), but not in the governance of the program (IEG, 2007: xxx).

Participation

1) The principle of participation means that people should be able to determine their own well-being and participate in the planning, design, monitoring and evaluation of decisions affecting them. Individuals must be able to take part in the conduct of public affairs, including the adoption and implementation of state policies. The right to participate is guaranteed by several human rights instruments, for instance Article 25 of the International Covenant on Civil and Political Rights. Should be active, free and meaningful whether it is exercised directly or through intermediary organizations representing specific interests. Human rights-based approach requires both, the participatory formulation of the needed policy and legislative framework, and ensuring that participatory and democratic processes are institutionalized locally and nationally (including through capacity-building among families, communities and civil society to actively participate in relevant forums) (FAO, 2009c: 61). 2) Participation is the process through which stakeholders' influence and share control over priority setting, policy-making, resource allocations and access to public goods and services (FAO, 2009b: 116).

Partner(s)/Partnership(s)

Stakeholders who are involved in the governance or financing of the program (including the members of the governing, executive, and advisory bodies) (IEG, 2007: xxx).

(CGIAR) Partner(s)

Organizations and institutions that intentionally enter into collaborative action with the CGIAR, as a participant of CGIAR activities (i.e. in analysis, decision-making or implementation), in a shared division of labor, through complementary activities, or by using research outputs. These actions may or may not be supported by formal agreements between the parties (CGIAR, 2008: 75).

(CGIAR) Strategic Partner(s)

Partners that share long-term interests, goals, and objectives with the CGIAR (CGIAR, 2008: 75).

Path-dependence

The dependence of institutional choices and economic outcomes on the path of previous choices and outcomes, rather than simply on current conditions. In path-dependent processes, institutions are self-reinforcing, history has an enduring influence, and choices are made on the basis of transitory conditions that persist long after these conditions change (IEG, 2007: xxx).

Performance Monitoring

A continuous process of collecting and analyzing data to compare how well a policy, program, or project is being implemented against expected results (IEG, 2007: xxiv).

Polyculture

Different mix of crops, trees, animals, fish to ensure variety of food, fodder and fibre sources and complementary use of natural resources. It also brings more ecosystem stability. Mixed cropping is a system of sowing two or three crops together on the same land, one being the main crop and the others the subsidiaries (FAO, 2009b: 35).

Production

Production means the operations undertaken to supply agricultural products in the state in which they occur on the farm, including initial packaging and labelling of the product (FAO, 2009b: 122).

Public Good(s)

Goods which produce benefits that are non-rival (many people can consume, use, or enjoy the good at the same time) and non-excludable (it is difficult to prevent people who do not pay for the good from consuming it). If the benefits of a particular public good accrue across all or many countries, then the good is deemed a global or international public good (IEG, 2007: xxx).

(International) Public Good(s)

International public goods, global and regional, address issues that: a) are deemed to be important to the international community, to both developed and developing countries; b) typically cannot, or will not, be adequately addressed by individual countries or entities acting alone; and, in such cases c) are best addressed collectively on a multilateral basis (IEG, 2007: 86).

(Global and Regional) Public Good(s) Research
(In this report) global and regional public goods research is: i) Research that produces environmentally friendly technologies, knowledge, or information relevant for reducing poverty in developing countries and with potential for large spill-overs and economies of scale, and ii) Research that is not easily conducted by national systems of developing countries themselves (World Bank OED, 2003: 3).

Purchasing Power Parity (PPP)

The purchasing power of a currency is expressed using a basket of goods and services that can be bought with a given amount in the home country. International comparison of, e.g., Gross Domestic Products of countries can be based on the purchasing power of currencies rather than on current exchange rates. PPP estimates tend to lower per capita GDPs in industrialized countries and raise per capita GDPs in developing countries (Metz et al., 2007).

Q R

Reforestation

This process increases the capacity of the land to sequester carbon by replanting forest biomass in areas where forests have been previously harvested (World Bank Carbon Finance Fund, 2010).

Re-localization of Food Production

Bringing back food production to where it is consumed and building alternative networks for getting food from farm to plate through short supply chains. Entails decreasing imports, eventually saving on transportation energy and enhancing food self-sufficiency (FAO, 2009b: 123).

Resilience

The ability of an ecosystem to withstand change or, when changed, to develop forces leading back to the original condition. Assessed by

examining factors such as population fluctuation, resistance to disturbance, speed of recovery after disturbance, and persistence of community composition. While resilience refers to the ability of the system to recover from a change, ecological stability expresses the resistance of an ecosystem against change (FAO, 2009b: 124).

Resource(s)

The inputs that are used in the activities of a program. Broadly speaking, the term encompasses natural, physical, financial, human, and social resources (IEG, 2007: xxxi).

Result(s)

The outputs, outcomes, or impacts (intended or unintended, positive or negative) of a development intervention (IEG, 2007: xxiv).

Results-Based Management

A management strategy focusing on performance and achievement of outputs, outcomes, and impacts (IEG, 2007: xxiv).

Right to be free from hunger

Freedom from hunger is the only right qualified as "fundamental" by the ICESCR (art.11.2). It is considered the minimum core content of the human right to food: the minimum level which should be secured for all whatever the level of development of a given state. Under this right, state authorities must ensure that no one is purposefully deprived of food or left to starve by actions or omissions of public officials; they must take positive measures to protect persons suffering from hunger or who are at risk of suffering from hunger (FAO, 2009c: 71).

Rural-Urban Network

Rural-urban networks facilitate the flow of agricultural and other commodities from rural producers to urban consumers. Overall, synergy between agricultural production and urban-based enterprises is key to the development of more vibrant local economies and less unequal and more "pro-poor" regional economic growth (FAO, 2009b: 128).

S

Shareholder

The subset of donors that are involved in the governance of the program. Therefore, this does not include individual (particularly anonymous) donors who choose not to be so involved, or who are not entitled to be involved if their contribution does not meet the minimum requirement, say, for membership on the governing body (IEG, 2007: xxxi).

Social Capital

The value attached to relationships constitutes a form of capital, which has come to be known as social capital. This includes a person's contacts and networks; the common rules, norms and sanctions that regulate behaviour together with the reciprocity and exchanges that build friendships, respect and ultimately trust. Three types of social capital are commonly identified. These are the ability to work positively with those closest to us who share similar values (referred to as bonding social capital). Working effectively with those who have dissimilar values and goals is called 'bridging social capital'. Finally the ability to engage positively with those in authority either to influence their policies or garner resources is termed linking social capital (Hall and Pretty, 2008; Pretty, 2003).

Soil Degradation

The process including deterioration of chemical, biological and physical soil properties, in which the productive capacity of soil is reduced (FAO, 2009a: 57).

Stakeholder

The parties who are interested in or affected, either positively or negatively, by the program. Stakeholders are often referred to as "principal" and "other," or "direct" and "indirect." While other or indirect stakeholders — such as taxpayers in both donor and beneficiary countries, visitors to a beneficiary country, and other indirect beneficiaries — may have interests as well, these are not ordinarily considered in evaluations unless a principal stakeholder acts as their proxy (IEG, 2007: xxxi).

Subsistence Farm

When the farm produces enough to feed only the farmer household and there is no surplus to sell (FAO, 2009b: 139).

Sustainability

1) When the term is **applied to the activities of a program**, the extent to which the benefits arising from these activities are likely to continue after the activities have been completed. When the term is applied to **organizations or programs** themselves, the extent to which the organization or program is likely to continue its operational activities over time (IEG, 2007: xxxii); 2) The principle of sustainability **when applied to the environment** implies the use of resources at rates that do not exceed the capacity of the earth to replace them. Thus water is used at a rate replenished by rainfall, greenhouse gas emissions are balanced by carbon fixation and storage, soil degradation and biodiversity loss are halted, and nutrient run-off does not accumulate excessively in the environment. Capture fisheries and other renewable resources are not depleted beyond their capacity to recover. Sustainability also extends to financial and human capital; food production must create sufficient wealth to maintain a viable and healthy work force, and intellectual and craft skills must be transmitted to future generations of producers. Sustainability also entails resilience, such that the food system, including its human and organisational components, is sufficiently robust to at least moderate shocks and stresses. By definition, dependency on non-renewable inputs is unsustainable even if in the short-term it is necessary as part of a trajectory towards sustainability (Godfray et al., 2010).

Sustainable Development

1) Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (UNFCCC, 2010). 2) The concept of sustainable development was introduced in the World Conservation Strategy (IUCN 1980) and had its roots in the concept of a sustainable society and in the management of renewable resources. Adopted by the WCED in 1987 and by the Rio Conference in 1992 as a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations. SD integrates the

political, social, economic and environmental dimensions (Metz et al., 2007).

Sustainable Intensification

Producing more food from the same area of land while reducing the environmental impacts requires what has been called sustainable intensification. In exactly the same way that yields can be increased using existing technologies, many options currently exist to reduce negative externalities. Reductions in some greenhouse gas emissions can potentially be achieved by changing agronomic practices, the adoption of integrated pest management methods, the integrated management of waste in livestock production, and the use of agroforestry. However, the effects of different agronomic practices on the full range of greenhouse gases can be very complex and may depend on the temporal and spatial scale of measurement. More research is required to allow a better assessment of competing policy options. Strategies such as zero or reduced tillage (the reduction in inversion ploughing), contour farming, mulches and cover crops improve water conservation and soil conservation, as does the application of practices designed explicitly for water and soil conservation such as. Precision agriculture refers to a series of technologies that allow the application of water, nutrients and pesticides only to the places and at the times they are required, so reducing the total use of inputs. Many inputs are commonly applied as insurance against loss of yields and education and incentive mechanisms can be developed to reduce their prophylactic use. Finally, agricultural land and water bodies used for aquaculture and fisheries can be managed in ways specifically designed to reduce negative impacts on biodiversity (Godfray et al., 2010).

Systems Approach

The consideration of different interacting parts of a distinct entity (i.e. system). In a food system, this involves the integration of all bio-physical and sociopolitical variables involved in the performance of the system (FAO, 2009b: 140).

T

Technology Transfer

The exchange of knowledge, hardware and associated software, money and goods among stakeholders, which leads to the spreading of the technology. The term encompasses both diffusion of technologies and technological cooperation across and within countries (Metz et al., 2007).

Transparency

Transparency refers to open access by the public to timely and reliable information on the decisions and performance of public authorities. Holders of public office should be as open as possible about all the decisions and actions that they take that may affect the free exercise of the right to food. The right-holders must be provided with essential information about the decision-making process and who is accountable and responsible for what (FAO, 2009c: 83).

U

Undernutrition

Undernutrition is a general term that indicates a lack of some or all nutritional elements necessary for human health. The World Food Programme defines it as a state in which the physical function of an individual is impaired to the point where he or she can no longer maintain natural bodily capacities such as growth, pregnancy, lactation, learning abilities, physical work and resisting and recovering from disease. The total amount of energy and protein needed by an individual varies greatly according to age, sex, body size, the amount of physical activity and, to some extent, climate conditions. Extra energy is needed during pregnancy and lactation (FAO, 2009c: 84).

V

Value Chain Approach

Value chain approaches means development interventions which look at whole value chains – from access to means of production, possibly processing, and marketing to the end user or consumer. The actual intervention will target

bottlenecks or critical links in the chain, which offer opportunities or remove constraints for a desired outcome (FAO, 2009b: 145).

Vulnerability

1) Vulnerability is a probability or likelihood concept, because it can be seen as the result of: (a) the probability that a particular risk (or “hazardous event”) occurs, (b) the probability that a specific hazardous event or shock affects particular individuals, households, or groups of people, and (c) the probability that the affected household cannot withstand, or can only partially withstand, a particular risk impact. As such, the vulnerability concept can be applied to any human condition, from general wellbeing to specific disease. Here it is specifically applied to food security. The cumulative probabilities of (a) and (b) are usually termed: “exposure to risk”. Exposure to risk and capacity to withstand effectively a risk or shock are the two vulnerability dimensions that determine food insecurity outcomes (FAO, 2009c: 86); 2) (In the context of Climate Change) The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (UNFCCC, 2010).

X

Y

Z

W

Water Security

Water security means the reliable availability of an acceptable quantity and quality of water for production, livelihoods and health, coupled with an acceptable level of risk to society of unpredictable water-related impacts (e.g. climate variability). Water security has been defined as an overarching goal where “every person has access to enough safe water at affordable cost to lead a clean, healthy and productive life, while ensuring that the environment is protected and enhanced” (FAO, 2009b: 148).

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Annex A: Analysis and Recommendations related to Partnerships in External Program and Management Reviews (EPMRs), Challenge Programs External Reviews (CPEs) and other recent reports

**By Harry Palmier
Senior Institutional Development Specialist, CGIAR/The World Bank**

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I. CGIAR Centers EPMRs

A. Meta Evaluation of CGIAR EPMRs, August 2007

Reviewed 11 EPMRs: ICRISAT, IPGRI **2003**; IRRI **2004**; IFPRI, CIMMYT **2005**; CIFOR, ICARDA, ICRAF, ILRI, IWMI, WorldFish **2006**. Recommended that partnerships issues should be addressed as a System-level issue.

“A System-level issue arises where there is potential for gain through exploiting unrealized economies of scale, fixing market failure, creating incentives for voluntary cooperation among centers and ensuring adequate funding of the creation of System Public Goods and International Public Goods.

System-level issues remain in:

- Determining where a center should operate on the research-to-development continuum.
- The role of partnerships in carrying out research and how this relates to NARS, NGOs, regional organizations and ARIs.
- Evaluating policy-oriented research in the System.
- Identifying IPGs in integrated natural resources management.
- Alignment of centers: System priorities, structures, with other actors.”

“Recent EPMRs have been moving in the direction of recommend an innovations systems approach as a useful framework for analyzing the various choices a center must make among upstream and downstream partnerships, capacity building in support of IPG research and uptake, and how to ensure IPG production in decentralized research programs. In an environment in which resources are increasingly mobilized at the project level, the CGIAR cannot determine unilaterally where it operates on the research for development continuum. However, the CGIAR should develop a set of principles and guidelines that centers can use in negotiating their place on the continuum (including the production of IPGs).”

“Managing Complexity: IPGs, Partnerships and the Research for Development Continuum

The Meta Review noted that individual Panels of EPMRs converge or diverge on recommendations on key issues but assumed that all started their evaluation with five propositions:

1. The centers are in the business of reducing poverty; their comparative advantage in contributing to poverty reduction is the provision of international public goods (or significant regional public goods).
2. There are few “pure public goods” which fact gives rise to different interpretations of the “publicness” of centers’ outputs. This raises questions about its usefulness as a “zero-one” variable in allocating resources.
3. The CGIAR is committed to producing IPGs “in partnership” where it can exploit both its comparative advantage and collaborative advantage.
4. A center cannot choose its “position on the R for D continuum in isolation; this results from the interplay among donors, partners, other stakeholders and the center. The location of its activities, organizational structure and nature of work are simultaneously determined by its goals, partnership arrangements and funding.
5. Research increasingly involves partnerships with groups that have not been traditionally considered part of the agricultural knowledge system (ICT, life sciences, health sector and non-agricultural faculties).”

“EPMR observations on International Public Goods.

Based on the information extracted from the reviews and included in Annex 8, we put forward a number of observations with respect to IPGs, partnerships and positioning on the R for D continuum.

Observations for all centers are:

1. Comparative advantage must be viewed in a dynamic way: it can be created and lost. The comparative advantage of a center derived from its international and public character, its reputation for quality, and its fairness as an honest broker can be compromised by its actions.
2. A center must be prepared to go where it still maintains a comparative advantage, or can create one. [*The ICRISAT EPMR found that while ICRISAT lost its comparative advantage in NRM research in Asia, largely due to the rapid growth of Asian partners, it had much to offer NARS in Africa and should consider moving its headquarters there.*]
3. Project the Institute geographically with a limited footprint based on the demand for IPGs [*ILRI's strategy of projecting itself to Asia through the application of its system approach was seen as a good strategy for a center with limited resources. On the contrary ICRAF EPMR pointed out the dangers of expanding geographically with dispersed offices, attendants overheads and risk of diversion of resources from IPGs production.*]
4. The expected IPG output of a project should be defined at the research protocol stage and treated as an objective of research and not as a desirable by-product or add-on. (The corollary for donors is that budgeting time to write up the public-good scientific paper and resources for training of partners need to be adequately included in projects.
5. The use of refereed publications in internationally refereed journals as the most common indicator of public good output has not been satisfactory to panels and centers alike. However, panels have tried to choose a meaningful comparator organization based on size, resources, and nature of research. Paradoxically, they then use the same indicator across scientifically different divisions within the same institution which is conceptually as difficult as comparing all institutions on a single measure. [*The CGIAR Performance Measurement System is introducing indicators for different types of publications that will adequately represent the work of different centers. Since an indicator is useful in measuring magnitude and direction of change, there might be value in negotiating center-specific indicators that the EPMR can use for evaluation of the center over time.*]
6. Focus is essential. “The future development of the CGIAR is to position itself on a limited number of IPGs in an environment where more players are competing (IWMI panel).”

Policy-oriented centers received the following advice on IPG development:

1. Establish strategic partnerships with a limited number of ARIs (top-tiered universities) and prioritize partners for their ability to generate IPGs (IWMI). This implies that the center is also willing to invest in the generation of primary data and information that makes it a “partner of choice.” (WorldFish, IFPRI).
2. Centers usually have “niche” areas that they should exploit (e.g. IPGRI’s niche in studying the complementarity of conservation and use of PGR; IFPRI’s application of state-of-the-art tools for meaningful policy analysis using a mixture of publicly available data and information generated by IFPRI).
3. Synthesis and awareness materials may be considered legitimate IPGs given the mandate and role of the center (CIFOR). However, this may come with an admonition that the center is not making its contribution to the world of Science. (CIFOR, ICRAF)
4. Understanding innovation processes and constraints to “up-scaling” can be generated through comparative cases studies. Unfortunately few of these studies are consciously planned and funded as comparative studies (for which donor funding is scarce. When IPG knowledge is mined from ad

hoc studies the reliability of the comparison is less and the effort is often an add-on to development-like activities rather than the principal output.

5. The development and application of tools can be a created comparative advantage and investment is needed to maintain it. EPMR's have recognized this in several cases, and have called for maintenance of the comparative advantage with focus on the work of the center. For example, IPGRI's lead in database management (a tool) should remain focused on PGR for impact. While the panel wonders if the comparative advantage of IFPRI in developing models will shift to universities, it sees a continued comparative advantage in the application of such tools and the synthesis of its own original information with others' information as a real IPG.
6. Centers must create IPGs in their area of expertise. "To be partner of choice (or even remain a partner) WorldFish should have very efficient roots in some selected ARIs in order to be really a co-producer of basic knowledge of interest and to be so at the first place to use them."

Commodity and systems-oriented centers were generally encouraged to return to their core business or niches where they have a comparative advantage:

- In commentary on CIMMYT, the Science Council re-emphasized "to all stakeholders the critical and vital role of germplasm-based gains in productivity, maintenance of past gains and risk avoidance in the overall CGIAR." The EPMR of ICRAF noted a previous comparative advantage in soil-related research, modeling and property rights and noted that the [increased] emphasis on socio-economic research resulted in a "reduction in upstream and output of IPGs in the form of technologies, technology systems and scientific publications."
- The EPMR of IRRI noted the competition to IRRI's lead in the genetics of rice coming from advanced research institutes in the developed countries and emerging countries such as China. One solution was for IRRI to assume a new "broker" role "to coordinate all the relevant information and see that it is made available to empower all via web-based systems." To do this, it would have to maintain its genomic work at the cutting edge. This same principle was expressed by another panel which argued that once you lose your cutting edge, you fall into a consulting mode where your currency is rapidly devalued.
- ILRI was encouraged to exploit the technological advantage created by BecA but not allow the tool to drag it into service functions outside its mandate which would push it into a service role on new diseases rather than a producer of IPG research on vaccines. Its geographical extension would be done through selective application of its systems approach in which biophysical research was part of the process.

The ecoregional centers were reminded of their technical base:

1. The panel noted that ICRISAT's best opportunity for IPGs is through the "full deployment of its biotechnology competence:" To do this it had a continuing interest and comparative advantage in working in India. The panel also commented that ICRISAT had not transferred IPG knowledge to Africa from its NRM work in Asia. An effort to do this was needed since ICRISAT no longer had a comparative advantage in doing this type of work in Asia where local NARS and NGOs were potential purveyors of such knowledge outside.
2. ICARDA was praised for its catching up on genomics and encouraged to bring biotechnology and crop improvement closer together. However, the panel did not see the analysis of "knowledge pathways" coming from its research for development projects as a major IPG where they had a comparative advantage vis-à-vis other organizations.
3. The ICRAF-African Highlands Initiative was investigated specifically for its downstream with a number of countries. As an ASARECA network (as well as ICRAF program) it potentially ran the risk of being pulled away from IPG research. The panel concluded that AHI did make a number of

methodological achievements in both biological and social domains (and more than were documented in publications)."

EPMR observations on natural resources management

NRM, as one area of research in the CGIAR, has always been difficult to assess. Some general principles coming from the reviews are:

1. In the policy area, the impact of NRM research is difficult to demonstrate for a variety of reasons: its long-term nature, multi-actor multi-sector approaches, and problems of attribution of output and credit to partners (ICRISAT).
2. The proposed joint effort of CIFOR, IWMI and WorldFish to develop a methodology for impact assessment was praised.
3. The integration of genetic, environmental and economic information remains the "holy grail" for commodity institutes (ICARDA, CIMMYT). Its use at a more macro level in national and regional planning is beginning. [*IFPRI blends multimarket modelling with the GIS tools of its spatial analysis group, crop modeling and economic surplus analysis to identify "development domains" for strategic planning at the national and regional levels in SSA.*]
4. The work in NRM is one of the first to incorporate aspects of gender and poverty alleviation. The relationship between access to resources, gender and poverty is central to resource-oriented centers (CIFOR, ICRAF, and WorldFish).
5. A commodity centers such as CIMMYT was urged to remember that its primary contribution was in germplasm enhancement and to leave crop-livestock interactions, INRM and "livelihoods analysis more broadly" to other actors.

The two ecoregional centers were challenged to see what IPGs could be transferred from their home base to other geographical regions of their mandate areas (e.g. ICARDA in dry areas other than CWANA, ICRISAT from Asia to SSA). In the case of NRM, it raises the question of the location specificity of their knowledge. [E.g. in the case of ICRISAT, *does the center's knowledge of water management in areas of highly intensive production translate to Africa? Does its strength in the exploitation of a major dataset on community development in India constitute an IPG lie in the applicability of its technique or in the understanding of the process of development?*]

Issues in inter-center collaboration having system-level significance

Modern science is carried out through networks and actors distributed around the world. Scientists have a propensity for collaboration if institutions do not get in their way. The EPMRs have made recommendations dealing with inter-center collaboration, collaboration with NARS partners, and advanced research institutes. Enhanced collaboration cannot be implemented by one center acting alone. Therefore, the issue of collaboration and better partnerships has system-level significance. Centers may develop partnership principles (most have formal policies) but the policies and incentives need to be put in place at a higher level. The Task Force on Sub-Saharan Africa demonstrated the degree to which collaboration issues are systemic and not individual. Donors such as CIDA make multi-stakeholder engagement a key element in their support; and Challenge Programs are designed to facilitate increased collaboration. New institutions such as the Alliance are built around collective action (e.g. regional plans) and rules and mechanisms such as the Alliance policies and practices are created to support such action. The evolution of Sub-Regional Organizations in SSA demonstrates the need for structures or mechanisms to interact with them on a continuous basis.

Inter-center collaboration appeared specifically in recommendations with respect to:

- WorldFish's expansion to Africa could be done in collaboration with IITA, WARDA, IRRI and CIFOR

- ICRAF should phase out its field office in LAC and maintain presence through the Amazon Initiative
- CIMMYT should collaborate with other centers through joint appointments o IPGRI should collaborate more closely with CIFOR and ICRAF on their shared agendas (including forestry resources databases)
- ILRI's hosting of BecA offers great potential as a platform for the ECA region (and beyond) but should not expose ILRI to excessive financial risks
- CIMMYT and ICARDA should rationalize and stabilize their relationship on the basis of their new MOU

The final bullet is only one example of several cases of overlapping regional mandates and global mandates that need to be addressed at the System level. Their appearance as continuing issues in successive reviews indicates systemic problems more than bilateral problems to be solved by MOUs. Actions to rationalize research support and administrative operations (IRRI-CIMMYT; WorldFish-IWMI, ICRAF-ILRI, IITA- WARD) are part of a higher-order discussion of System reform and are commented upon separately. While these issues may be mentioned by the panels it is usually to declare them beyond the TOR or competence (in a juridical sense) to deal with.

Observations on partnerships and capacity building

Partnerships and capacity building have often been opposite sides of the same coin. However, recent reviews have noted the growing competence of some NARS to provide IPGs and RPGs as alternative suppliers. This changes the role of the centers and the relationship of the partner to that of strategic ally or potential competitor.

A few key conclusions expressed in the individual reviews highlight continuing tension between the production of IPGs, the meaning of good partnership and the position of center activities on the research-for-development continuum.

1. "Partnerships need to support, not drive, strategic research programs" (ICRAF EPMR). Centers should choose their partners carefully according to their ability to contribute to the development of international public goods. The center should develop a partnership strategy (IWMI).
2. The need for a few strategic partners in ARIs is necessary if centers are to maintain their cutting edge (or even to remain serious players in the game) in the face of growing strength of partners, particularly in Asia.
3. Centers may need to form partnerships with other organizations to facilitate the uptake of their findings without becoming involved in the extension process.
4. Capacity building of partners may be necessary to help the center exit from downstream development. (NGOs are looking for capacity building in linking to science, governments are looking for policy frameworks, and research institutes and universities are looking for training and applied research).
5. Capacity building should be explicit in all projects and reported on as a discrete outcome.
6. Partnerships can contribute significantly to a center's ability to raise funds and contribute to science. An ICRAF CCER highlighted the benefits from working with pro-enterprise NGOs.
7. Partnership is not a magical solution. Some EPMRs note that it may take more resources to achieve production of an IPG through partnership than by working on one's own.

Observations on the research for development continuum

Where a center should be situated on the research-development continuum is a question raised in all EPMRs. While most EPMRs caution centers about neglecting IPG production to engage in the

enthusiasm of development, there are only a few examples where a center is actually said to have “breached the IPG obligation.” The nuanced language of the EPMRs, which “caution” rather than “recommend” may demonstrate a closer appreciation of the trade-offs a center must make to be a good partner, build capacity and have impact regionally while producing international public goods for global science and peer organizations. Essentially the centers must position themselves to thrive in the following environment: 1) in the CGIAR as a research system funded by development donors, 2) achieving the goal of poverty reduction through the production of international public goods, and 3) adopting decentralization/regionalization in response to partner needs and funding opportunities, and 5) establishing the partnerships required upstream and downstream to ensure cutting edge science and uptake of their public goods. Each of the reviews has come up with principles and suggestions that help centers resolve this debate at their own level.

The photographer Ansel Adams said “There is nothing worse than a clear image of a fuzzy concept.” This may explain as well the art of producing international public goods in partnerships upstream to access cutting edge science and downstream to ensure uptake in complex areas such as integrated natural resources management. The place of a center on the research for development continuum is simultaneously determined along with the need for capacity building by funding that is increasingly restricted and provided by donors with a development mission. As a key donor expressed it, the CGIAR cannot determine its place on the continuum alone. The complexity of dealing with these issues is complicated by the fact that there are few pure public goods and the notion of upstream and downstream is often interpreted to mean either ARIs versus NARS or “strategic and applied” versus “adaptive research and extension.”

In annex 7: EPMR Commendations as well as Recommendations. Table A7.1 includes a category “Centers explicitly commended for specific action or practice related to Partnership” which recognizes: ICARDA for Collective actions and consortium; ICRAF for SEA region partnerships; and ASB partnership award; IRRI for transforming Consortium for integrated multi-locational research into a “true partnership”.; IPGRI for work in regions as facilitator, technical adviser and partner; and WorldFish for establishing strategic alliance with ARIs.

Innovation Systems and Organization Culture

The CGIAR was an institutional innovation when it was created: international in nature, simple missions focusing on basic commodities of hungry people and difficult ecologies, producing public goods freely available to all, and attracting the best scientists through excellent working conditions and remuneration. If they had a tendency to become fortresses they reached out through their capacity building and gap-filling activities. While there is still need for some of these latter functions (and they are still prized) research is being carried out differently today.

The team feels there is a need for an innovation perspective at the System level supported by support for mechanisms that facilitate collaboration, partnerships, and still produce international public goods. Three quotes from the ILRI EPMR highlight some of the issues:

- [Enabling Innovation] is a difficult Theme to explicate, yet it is central to the ILRI research approach and is an indication of the creative manner in which ILRI tries to meet its wide mandate from a limited resource base....
- The ambitious objective of influencing the whole CGIAR was discernable in the panel’s interactions with other centers but further comment on this objective is beyond this EPMR....

- Overall, the panel wishes to highlight the Theme's success, but also emphasize that the approach is a current iteration of the continual ebb and flow of holistic versus reductionist approaches felt by all open-minded researchers.

The approach involves an "ethos of partnership" but also requires a culture and set of processes that support a more decentralized operation and demand-driven structure. The creation of an "Innovation Unit" attached to the DDG-R stresses that "innovation" is not just an academic field of study but a proposed way of doing business.

Our review of the EPMRs brought out other centers (IWMI, CIFOR, and WorldFish) where decentralization, partnership practices, and "IPG tensions" were signaled by the EPMRs. Whether their experimentation with these models was driven by size (relatively small centers), mandate (policy or systems) or a younger generation of leadership could be examined in the World Bank review. The ILRI EPMR panel rightly pointed out that this was beyond their TOR and this is why we see it as a system-level issue. We recommend that the Science Council review the programmatic implications of research carried out an innovation perspective and the way current mechanisms support or hinder such innovation.

There are a few assumptions that underlie this recommendation. It is assumed, first, that science will increasingly be carried out in a decentralized and distributed manner. Second, the countries that have strong NARS are also more likely to have strong private sectors. Third, the partners are differentiating into emerging countries (which may become partners and competitors) and those that are falling behind. There needs to be a System strategy for dealing with both cases.

At the center level, the EPMR panels have made comments on the internal processes for managing the decentralization (e.g. overheads of maintaining field offices, partner demands, developing synergies across regions within the centers and the difficulties of matrix management.) While the EPMRs alert the reader to the dangers of sacrificing IPG production to decentralized operations they have not strongly criticized a center for "breaching the IPG mandate." Our review further suggests that the private sector has significant experience in organizing in support of company's core business and appropriate consultants from the private sector could be brought in to assist centers in designing organizations. (A number of the observations on the management recommendations point out good practices.)

Toppling silos without creating culverts: Shifting structures and culture

At the System level, there is complex overlap of center, Challenge Programs and emerging Framework Programs in support of the System Priorities. At the inter-center level, there are system-wide initiatives, communities of practices and (in SSA) sub-regional plans for collaborative action. Each of these has strengths and weaknesses in a broader innovation perspective. The Alliance has set up conflict resolution mechanisms and some of the conflicts over regional and global mandates have already been resolved through bilateral memoranda of understanding between the affected centers.

The Meta Review team concluded that an integrating framework such as the "agricultural innovation system" is necessary to explain the equilibrium position of a center and the points of intervention at the center and higher levels needed to change this position. The devil is in the detail and several recent reviews use some concept of a knowledge system or innovation perspective as useful for organizing the center's own work and not just an area of research applied to the uptake of technologies by NARS. This again an area where there is no right answer but a good framework may help a center find the "best fit." The review team also concluded that lessons for organizing the production of IPGs in a decentralized

and partnership mode would learn much by going outside the System to NGOs, other sectors such as health, and the private sector

In its Conclusions the Meta Evaluation confirmed the essential roles that the EPMR process plays in the CGIAR: evaluative, transformative, supportive and even prospective. The EPMR is an essential anchor of an emerging integrated system of evaluation comprised of MTPs, the PMS, CCERs, EPMRs and periodic evaluation of the CGIAR itself. While its principal role is evaluative, an EPMR may help transform a center at a critical juncture, provide useful advice for improvement and make conceptual contributions to the way research should be planned, organized and carried out in the System. But there were cross-cutting system-level issues that are visible by their absence in the reviews. The System has evolved in an organic fashion. The Science Council is charged with rational planning for the System. The rational side of planning for an organic system is complemented by consultative and decision-making processes that are evolving with the System. Based on the suggestions made by the EPMRs on many issues that lied outside their TOR and where solutions were beyond the capacity or competence of a single center, the Meta evaluation indicated that system level solutions be found for the need for the System to position itself on the research-development continuum while recognizing the position of individual centers will be quite different as a function of the nature of their IPG outputs, partnerships needed to produce and ensure uptake of those IPGs, and organizational options for interaction.

B. Africa Rice Center / WARDA, 5th EPMR, January 2008

Example of Program: WARDA-P02: Sustainable Productivity Enhancement

Project Overview and Rationale:

Rationale

In sub-Saharan Africa rice is cultivated in four different ecologies: in rainfed uplands, in lowlands with varying degrees of water control in deep water, and in mangrove swamps. The last two ecologies, deep water and mangrove swamps are locally vital but have limited regional importance and, therefore, do not feature on WARDA's research agenda. The research mandate of these ecologies has been handed over to national researchers that are backstopped by WARDA staff. The remaining two ecologies have mutual but also ecology-specific constraints and opportunities. Rice cultivation presently covers 6.7 million hectares, 2.7 Mha (or 37%) of which is devoted to upland ecosystems, mostly in the moist savannah and humid forest zones, and contributing 19% to the total rice production in SSA. Yields in the uplands are constrained by frequent drought, low soil fertility (due to deficiencies of N, P) and soil acidity. Rice production is further hampered by biotic stresses such as blast disease, stem borers, termites and weeds. Lowland rice is produced on 4 Mha; three quarters of it is rainfed (contributing 48% to the total rice production in SSA), while one quarter is irrigated (contributing 33% to the total rice production in SSA). Irrigated rice and associated production systems are generally input intensive and market oriented. Rice yield gaps between attainable and actual yields are high, even in input-intensive systems. Attainable yields with full water control are in the range of 7 to 9 tons ha⁻¹, while actual paddy yields on farmers fields are 3 to 6 tons ha⁻¹. The attainable yield without full water control is 4 to 5 tons ha⁻¹, while the actual yield is typically 1 to 3 tons ha⁻¹. To close the yield gaps, improved crop and NRM options are being generated and adapted to address the major constraints of irrigated rice-based systems. Major constraints are a lack of water control, weed management, and to a lesser extent soil fertility, iron toxicity, African rice gall midge (AfRGM), and rice yellow mottle virus (RYMV). The options for integrated crop and NRM management, targeting water-saving, labor-saving, gains in yield and

product quality, reduced production costs, are developed with farmers at the farm and village levels. Improving water use efficiency can make dramatic contributions to increasing productivity and household food security, and enhance market opportunities. Moreover, increased water availability provides the opportunity to grow more than one crop per year. However, land use intensification should not endanger environmental services of lowlands, such as the water buffering capacity and natural biodiversity. Intensification can also result in build-up of pests and diseases, while degradation of the resource base can lead to abandonment of the site. New challenges include competition for water with increasing demand from urbanization and expansion of irrigation schemes, and climate change, which may lead to a drop in water availability and increasing incidences of salinity and alkalinity. Finally, integrated systems, like rice and aquaculture, livestock, vegetables, and fruit trees offer an array of opportunities for intensification and diversification, leading to additional income and improved nutrition for the farming community.

Goal: Contribute to food security and well-being of rice producers and consumers in Africa.

Impact Pathways by Output

Output 1: Integrated management options for weeds, pests and diseases available.

The tools and management options developed in Output 1 will be developed with NARES collaborators in partnership with farmers to analyze the relative magnitude of yield loss (spatial and temporal variability) and loss in profitability due to biotic stresses. NARS partners will be trained in the use of decision tools and the outcome of such tools (alternative management options) will be used to advise farmers on ways to reduce the reliance on agro-chemicals, and minimize the impact on the environment. Such tools will be included in training modules and will also allow to derive extension messages (posters, radio scripts, videos) that will be distributed through PLAR training (working with national extension agencies, NGOs and farmer organizations), and WARDA's rice networks, such as IVC, ROCARIZ, ECARRN and ARI. Alternative management in farmers' fields will lead to enhanced rice productivity and reduced negative impact on the environment.

Output 2: Sustainable intensification options for rice-based systems developed.

This output 2 focuses on developing knowledge and innovation capacity and systems and modeling tools aimed to increase the efficiency of rice-based systems and improve food production, with a special focus on water and nutrient management. One pathway will include training of NARS researchers on the use of such systems and modeling tools. Another pathway will use the tools to derive site-specific options that allow enhanced nutrient and water efficiency in farmers' fields that are translated in extension messages (posters, radio scripts, videos) distributed through PLAR training (aimed at national extension agencies, NGOs and farmer organizations) and WARDA's rice networks, such as IVC, ROCARIZ, ECARRN and ARI.

Output 3: Profitable opportunities for diversification of the farmers' portfolio of enterprises made available.

Output 3 aims at increasing the possibility of diversification for increased human health from an increased variety of products as well as increased income from the inclusion of high-value commodities like fish and vegetables. Technologies and management options will be tested at key sites with NARS partners and in partnership with farmers. Successful technologies and management options will be

scaled-out through NGOs, national extension agencies and farmer organizations to benefit farmers and increase their income and nutritional status using extension messages such as posters, radio scripts, videos and through PLAR training and through WARDA's rice networks such as IVC, ROCARIZ, ECARRN and ARI.

Output 4: Use of environmental services optimized and safeguarded for future generations.

Output 4 will provide methodologies to assess the relative importance of various environmental goods and services and will develop management options to counter negative environmental impacts of rice-system development for direct and in-direct (e.g. downstream) users. The methodologies and tools that will be developed in partnership with NARS partners will allow ex-ante assessment of different land and water use scenarios taking into account environmental and climate change. Actions by farmers, and other stakeholders (up and downstream) based on the outcome of these tools will reduce the risk of jeopardizing the quality of natural resources in rice-based systems. Such tools will be available on dedicated websites and further outscaled through focused training courses and are likely to be used by CGIAR and NARS scientists, extension staff and policy and decision makers. Direct and indirect users of environmental services and goods of rice-based systems will become aware of promising management options developed in this output through publications, radio scripts, and videos with a strong link to the IVC.

International Public Goods

The program takes a broad view of the development and innovation context of rice-based systems, in close collaboration with Program 3 and Program 4. At the regional and national level, challenges and opportunities for intensification and diversification of rice-based systems are identified, including current and potential rice-based systems performance, access to markets, water availability, soil quality, etc. Multi-stakeholder platforms (MSPs) involving NARES partners and other stakeholders are formed to ensure joined research agenda setting and stimulate co-learning. Research activities are planned and implemented in partnerships with NARES partners, sister CG centers, and AROs in several countries and at strategically selected sites based on jointly identified research themes and priorities identified by the MSPs that fit within WARDA's Strategic Plan and MTP. The multi-country and multi-location approach ensures that results obtained are valid for a broad range of biophysical and socio-economic settings. It will also facilitate the development of IPGs, such as modeling tools of varying complexity, maps, databases, learning tools and resource management decision tools that can be used for up- and out-scaling of results and for ex-ante impact analyses.

WARDA MTP 2010-12

Alignment to CGIAR Priorities Program 2 contribution the CGIAR System Priorities				
Priority Area 1: Sustaining Biodiversity	Priority Area 2 Genetic Improvements	Priority Area 3 Diversification and High-value Commodities	Priority Area 4 Sustainable Management of Natural Resources	Priority Area 5: Policies and Institutional Innovation

1a - Conservation of plant genetic resources for food and agriculture	2a – Maintaining and enhancing yield of food staples	3a – Increasing income from fruit and vegetables	4a - Promoting integrated land, water and forest management at landscape level	5a - Science and technology policies and institutions
1b- Promoting conservation and characterization of under-utilized plant genetic resources to increase income	2b – Improving tolerance to selected abiotic stresses	3b – Increasing income from livestock	4b - Sustaining and managing aquatic ecosystems for food and livelihoods	5b - Making international and domestic markets work for the poor
1c - Conservation of indigenous livestock	2c - Enhancing nutritional quality and safety	3c – Enhancing income through increased productivity of fisheries and aquaculture	4c – Improving water productivity	5c - Rural institutions and their governance
1d - Conservation of aquatic animal genetic resources	2d - Genetic enhancement of high value species	3d – Promoting sustainable income generation from forests and trees	4d – Promoting sustainable agro-ecological intensification in low- and high-potential environments	5d – Improving research and development options to reduce rural poverty and vulnerability

Elaboration of Partners Roles	Role	Output
Partner		
Universities		
University of Hanover (Germany)	Joint project on Bacterial Leaf Blight (BLB) in Burkina Faso, Benin, Mali, Niger, Senegal, Togo and a joint proposal called Mitigating the impact of climate change on rice disease resistance in East Africa	1
University of Sheffield (UK)	Joint project on Striga sp. in rice in Cote d'Ivoire and Tanzania	1
Gaston Berger University (Senegal)	Joint project on elements of rice system intensification in Senegal	2
University of California Santa-Cruz (USA)	Joint project on elements of rice system intensification in Senegal	2
University of Hohenheim	Joint project on adaptation to	4

(Germany)	climate change in Mali, Senegal and Madagascar	
Partner Wageningen University (the Netherlands)	Role Adaptation of simulation tools and environmental degradation, climate change in Benin, Senegal, Ethiopia, Zimbabwe	Output 4
CAAS	Joint project called Green Super Rice for the Resource Poor in Africa and Asia in Nigeria, Rwanda, Tanzania, Mali, Senegal, Liberia, Mozambique and Uganda	1, 2
IARC IRRI	Joint project called Green Super Rice for the Resource Poor in Africa and Asia in Nigeria, Rwanda, Tanzania, Mali, Senegal, Liberia, Mozambique and Uganda	1, 2
WorldFish	Joint project on Community-based Fish Culture in Mali	3
ARI CIRAD (France)	Joint project on adaptation to climate change in Mali, Senegal and Madagascar, seconded vegetable scientist in Benin and seconded crop modeler in Senegal	3, 4

C. IWMI 3rd EPMR, January 2008

Science Council Commentary on the Third External Program and Management Review (EPMR) of the International Water Management Institute (IWMI), April 2007

Publications

IWMI questions the use of ISI as a primary indicator of a Center's performance, especially considering the multi-disciplinary nature of their work, i.e., not as easy to publish interdisciplinary research. The SC maintains that publications is one of the most widely accepted basis for evaluating research quality, and assuming the work is relevant, is likely to be a strong indicator of the potential for future impact. The SC does not agree with the Center's characterization of the Panel as giving IWMI advice to reform itself in the direction of "a university with disciplinary departments that favor 'deep science' and where publications dominates all else". Rather, in the SC's view, the Panel is urging the Center to establish a solid basis for conducting good, rigorous science such that results emerging are valid and robust that is more likely to lead to improved technologies, policies and institutions and, ultimately, to impact on the ground. The SC believes that good science and impact go together and suggests that lack of impact at IWMI may at least in part be explained by a slow drift away from good disciplinary based science.

The Center's response to the adverse comments of the panel about their peer publication record by resorting to the argument that impacts are more important than publications is unconvincing. Firstly, these should not be viewed as substitutes but complements and secondly, and more importantly, IWMI is one of the poorest performing centers as far as the documentation of its impact is concerned in the 3a and 3b components of the PM exercise.

IWMI as a 'Knowledge Center'

At the time of the 2nd EPMR the Center had a strong research orientation and was focused on increasing the amount of 'crop per drop'. In the past six years this focus has changed to that of a Knowledge Center that involves not only IWMI's outputs but those of multiple partners. In-depth (disciplinary) research was de-emphasized in favor of inter-disciplinary research with its ancillary complexities and transaction costs. The Panel rightly suggests that this shift threatens the ability of the Center to "deliver cutting edge research outputs" and makes a number of remedial propositions such as improved mentoring of younger staff, restructuring of the leadership team and a professional development program. The SC accepts the analysis and agrees that some of the suggested remedies might alleviate the problem, but sees room for alternative measures that the new DG might wish to pursue.

The report suggests a move back to a stronger disciplinary-oriented scientific research paradigm. The SC concurs with the Panel that roles such as brokering, sharing, application should be complements to IWMI's research along the impact pathway and not alternatives. The forthcoming meta-review of EPMRs should assess whether such "pendulum swings" are justified or not.

Also, in the context of becoming a Knowledge Center, IWMI has inevitably greatly expanded its partnerships and drifted rather far downstream on the research – development continuum. The Panel questions whether IWMI could legitimately claim that 80% of its activities could be placed in the SP agenda that should lead to IPGs. Indeed, the panel's analysis of several of the IWMI's research programs indicates that much of the research is not IPG oriented and does not build on past research and comparative advantage sufficiently by way of synthesis reports. This requires attention. The SC would agree with the panel that the R-D balance be reconsidered in the context of developing a new strategic plan.

Partnerships

The panel noted that relatively few of IWMI's publications are with partners. It is of concern that IWMI's partnerships are questioned in a number of places by the panel. There are issues of their number and type and the need for IWMI to be more strategic and selective if it is to pursue an IPG agenda and if it is to become a center of preference for collaboration by other research providers. Of concern to the SC also is the apparent tension between IWMI and IFPRI resulting in competing rather than collaboration in water policy research; and there are poor host country relationships.

There are tensions between the CP on W&F and IWMI as evidenced by the recent criticisms of the CP competitive grants process by some partners. The Steering Committee arrangements require scrutiny and the forthcoming review of the CP is timely. It is fortunate that Dr Bennett has agreed to be involved in the CP review as he now has a full understanding of IWMI and can approach the review of the CP with full information.

IWMI Response to the 3rd External Program and Management Review of IWMI

Introduction

IWMI much appreciates the careful and in-depth evaluation the Panel has undertaken of its work over the period under review. IWMI is pleased that the Panel's overall conclusion is that IWMI has emerged from its period of rapid growth as a larger, more diverse, more proactive and generally stronger research organization. IWMI agrees there is now an opportunity for refinement, clear specification of research questions, deeper partnerships and a focus on generating and better measuring outcomes and impacts through this larger, stronger organization. IWMI agrees with the large majority of the Panel's recommendations and fully intends to use the Panel's careful analysis as a guide for the way forward in the years to come, starting with a new Strategic Plan exercise in 2008.

In 2007 the center is recruiting a new Director General who will be charged with the implementation of the EPMP's recommendations; first and foremost the development of a new strategic plan that will be the primary vehicle for the implementation of many of the Panel's recommendations.

The review has also raised a number of questions, however, that appear to be going further than the review of IWMI alone, but touch directly on the mission and vision for the CGIAR as a research for development system as a whole. It may be a good moment to debate, as part of the IWMI review process, the difference in perspective on what the role and purpose of a CGIAR research institute is, and how that differs from a university, and how that may require a different approach to staffing and management. In some ways the well-thought out advice the Panel is giving IWMI is to reform itself more in the direction of a university, with disciplinary departments that favor "deep science" and where publication records dominate all else.

IWMI agrees that publications are one indicator of research quality. IWMI has instituted during the period under review a policy that sets clear expectations that every researcher generates at least 2 peer-reviewed publications every year and this is evaluated carefully as part of every researcher's performance evaluation. As a result IWMI's publication performance has improved and is currently better than at any time in its history (see Figure 1). IWMI also agrees with the Panel that there is still room for improvement and it expects to see such improvement through carefully targeted research and publication policies.

Where IWMI disagrees with the Panel is that the publication record should not be seen as the single most important test of the quality of the individual, the performance of the institution, or the suitability of individuals to be research managers. IWMI sees the publication performance as a necessary but not sufficient condition for the more important question: does the organization have impact on the ground. Particularly, IWMI does not believe that the publication record is the key indicator to determine the quality of a research manager. Some very good researchers have shown themselves to be lousy managers; this has been widely recognized in many formal research and education institutions. IWMI has deliberately recruited a small number of people who are better people managers and understand both project management and "development", without necessarily being well-published researchers. We also propose that making decisions about research and the impact of research is strengthened by mixing staff with managerial competence with those with research competence. We believe this is in line with management training and practice that encourages team results from the best use of individual skills from different people.

A key issue for IWMI is that it prides itself on being a multidisciplinary center; where research is formulated in terms of the problem (rather than the disciplinary research question) and where people are selected who are willing and able to look over disciplinary boundaries. In its recruitment, therefore, IWMI examines the range of experiences, both pre- and post-PhD, of its applicants and has selected several with non-standard career paths, which gives them a demonstrated edge in a multidisciplinary work and being able to relate to partners and beneficiaries of the research. This is in the midst of an era where integrated solutions to the important problems we face with water management are being encouraged at an international level as well as locally. The Panel takes the traditional view of counting only the discipline of a researcher's PhD and their experience as years after the PhD was obtained. The reference to 'time since PhD' is also somewhat narrow culturally and reflects a standard western academic research career, i.e. the person studies and enters academia and thence builds a research-based career, whereas other degree and training schemes build on prior or parallel learning and research with the PhD being an outcome of research development, and not a ticket into research. Further, IWMI has also purposefully recruited some scientists who have taken the time to gain experience in management, or gaining wider multi-cultural understanding of the areas where they work, hence strengthening their roles and capability in a research institution; this would seem to support the Panel's emphasis on sound management, but does not follow the singular pathway that they have opted to promote and recommend for IWMI.

As a result, the Panel and IWMI have some differing perspectives on the disciplinary mix at IWMI; the suitability of the management team to manage the organization; and the question of whether there are enough disciplinary specialists at IWMI to mentor junior scientists. CGIAR centers also differ from top-tier universities in that they serve the interests of both the research community as well as the CGIAR members to whom the relevance of the science to development and the ultimate impact on the ground are a very high priority. The bottom line is whether IWMI's final output is only measured in terms of ISI-journal publications, or whether CGIAR centers ought to go further downstream in ensuring that the knowledge they generate can be used, and is. This debate is not new and will continue and IWMI encourages its pursuit throughout the CGIAR: IWMI intends to remain at the centre of this debate and through experience and ongoing excellence in science *and* knowledge exchange to contribute through action, not just philosophy. IWMI has developed a strategy to become a "knowledge center", to ensure that its knowledge gets used and has impact, and we welcome the Panel's advice on placing more emphasis on how we assess impact. In IWMI's view the knowledge sharing activities are not a diversion of research funds to other purposes, but are intended to change the research itself, so that it becomes a more effective process in pursuit of our mandate. The panel favors an approach where IWMI leaves knowledge sharing and associated activities, which are "post-research functions" in its view, to other specialists and stick with its core function: generating knowledge and publishing that in ISI journals. We accept that we need to continuously assess the balance and the effectiveness of these conjoint approaches and welcome comment by applied and more academic researchers and stakeholders.

Response to Recommendations

Partnerships

Recommendation 12. The Panel recommends that IWMI prioritize its list of partners and develop a new partnership strategy that is linked to this list. IWMI must further make its decentralized research structure work in favor of improving relationships with its partners including sharing credit for outputs.

Response: **Agreed.** IWMI agrees that IWMI's strongly increased emphasis on a partnership-based approach to research has led to a very large expansion of the number of partners IWMI deals with, which may not almost lead to the most effective partnerships possible. IWMI proposes to develop a new partnership strategy, and work out the roles of each of the partners more clearly, as part of the new strategic plan. While IWMI is convinced that its decentralized, benchmark-basin focused structure has helped tremendously in forging closer links with partners and increasing IWMI's impacts, it agrees with the Panel that relationships with partners can continuously be improved and particularly the sharing of credit for outputs – as measured by publications co-authored with partners – can and should be improved considerably.

Recommendation 13. The Panel recommends IWMI make a stronger effort to link up with top tier universities/research institutes that have a reputation in the water resources area, and develop opportunities for their staff to play an active role in IWMI, including supervising PhD students, mentoring junior staff and assisting in the development of a strengthened research program.

Response: **Agreed.** IWMI agrees that a good relationship with top-tier universities is important; likewise IWMI plays a capacity building role with other, less strong universities, building their expertise in the water resources area. IWMI has traditionally had strong relationships with a small group of top-tier universities (Cornell and Wageningen, particularly). Under the period under review, IWMI has strongly expanded the number of universities with which it has joint PhD students; universities in Asia, Africa, Australia as well as the US and Europe. IWMI agrees that as part of a more focused partnership strategy (recommendation 12), it should also more clearly define its relationship with its partner universities.

Panel Report

IPG tensions

In determining the research direction taken by IWMI through its selection of projects, the senior research decision making team must take into account the mandate of the organization, as defined by the Board in the context of the CGIAR's mission. Specifically this is the provision of research that delivers outcomes that can be classified as IPGs. This is the linchpin of both the Strategic Plans and Medium Term Plans of the organization and sets the overall direction of the organization's research. The implication is that the benefits of the research carried out are available to all – internationally - once they are produced. They will not offer the potential of a direct revenue flow to the research provider. Complying with this mandate creates funding pressures for IWMI in that it restricts the range of funding sources to which it can appeal. In contrast, research can be directed to providing excludable profit generating private goods, especially at a geographically localized scale. Because of the exclusive nature of this type of research product, clients are willing to pay for its provision. This is the province of the private consulting company and potentially academic organizations with particular localized connections.

The public/private local/global dichotomies are not so clear cut in practice. Most research work involves elements of all types of outputs. The research spectrum is thus better described as a continuum between the extremes of pure public and pure private, pure local and pure global. So while IWMI has the mandate of providing IPG research, there is appeal in securing funding by moving toward research that has a greater proportion of private or local public good outputs. Such funding may be provided by donors seeking to improve the well being of particular farmers in specific developing countries and so may be difficult to distinguish from IPG research, especially when poverty issues muddy the relevance of profits as an element in the definition of private goods. The choice as to how far along the

public/private, local/global spectrum of research is therefore one that involves tension that is not readily resolved.

The tension is manifest in the degree to which IWMI becomes involved in the extension of its research findings. IPG research findings may be technically available to all once the knowledge is created but significant barriers may exist to its dissemination to those who may benefit from it. The degree to which IWMI becomes involved in delivering its findings to potential beneficiaries in some ways describes the path between public and private research. It is suggested that IWMI better monitor its efforts to develop mechanisms – including the formation of partnerships with other organizations such as government agencies NARs and NGOs – to facilitate the up-take of its findings without direct involvement in the extension process in order to ensure the benefits of its research can be identified and valued without breaching its CGIAR mandate to provide IPG research.

The Panel recognizes the value of the Strategic Plan and Medium Term Plan approach adopted by IWMI in providing overall direction to the research task and particularly commends the use of partner inputs into the strategic planning process; it remains concerned at the lack of systematic, objective ex post and ex ante evaluations of research in the process. For example, there have been very few formal ex post assessments of research projects on which to base decisions regarding the potential returns to be achieved from future possible research investments. Nor do research priorities appear to be established with reference to the findings of ex ante assessments of proposals submitted by researchers. As has been described, research priorities have rather been developed largely in consultation with donors and through internal discussions and appear somewhat *ad hoc*. Fund raising opportunities have clearly been critical in determining research direction.

The Panel concludes that the existing means of developing research priorities lacks sufficient objective assessment and finds this troublesome given the strong recommendation of the previous EPMR Panel to increase the Institute's efforts in research evaluation. The Panel is of the view that IWMI should place increased emphasis on the development of research evaluation processes – both ex ante and ex post – as a means of informing research priority setting.

Research Monitoring and Evaluation

6. Partnerships

6.1 Introduction

IWMI's vision for 2008 is to be a world class knowledge resource center on water, food and environment. IWMI states that it intends doing this through knowledge generation, sharing and brokerage via strategic partnerships with a set of core partners throughout Asia and Africa. The Strategic Plan 2000-2005 explicitly mentions IWMI's intention to work primarily with and through partners. The 2004-2008 Strategy puts further emphasis on the need for a collaborative working style in which partnerships form a key strategy. IWMI's Partnership Strategy (2004), gives a broad outline of why IWMI should partner and also suggests the purpose and scope for partnership in very general terms.

6.2 Partners Met and /or Contacted by the Panel

IWMI's relationships with stakeholders were assessed by the Panel through meetings held by Panel members with senior staff of several agencies, universities, and NGOs in Sri Lanka, India (Hyderabad), and South Africa. The visit to Laos was to the field sites out of Luang Prabang and thus interaction was limited to staff from IRD. Relationships between IWMI and the stakeholders met were varied, with some

as in the University of Kelaniya (Sri Lanka) being only one of subcontracting out the project, to ones where staff were seconded to work directly on IWMI projects. The Panel also contacted several CGIAR Heads, bi-lateral and multi-lateral donors and spoke to a wide range of individuals who had been associated with IWMI in the past in various capacities. (See Annex IV for a list of partners/stakeholders met and /or corresponded with).

6.3 Type of Partnerships

The Panel was provided with a short paper which described IWMI's partnership strategy in very general terms. IWMI maintains that it has different sets of partners, each adding value to its work in different ways: partnerships to gain access to cutting –edge research, partnerships to build capacity for water management research in the South, partnerships to gain international influence for results of its research, and partnerships with organizations that can be downstream of IWMI and do more of the extension parts in the research-development continuum. The Panel however was given a listing of partners which highlighted some as key partners and these were simply described as those the Center had "active interaction with". The Panel found it difficult to understand whether this meant in terms of funding, frequency of meeting or some other characteristic, underscoring the fact that IWMI needs to prioritize its list of partners in a systematic way if it is to link it effectively with its partnership strategy. A look at the list given showed 76 NARS partners, 24 NGO partners, 90 academic institutions (both advanced research and universities), 6 multilateral banks and donors³⁹ and several CGIAR Centers. Only the Swiss Development Corporation was listed as a donor!! We are assuming that the World Bank, ADB and others are sometimes partners but at other times donors. The list was not complete hence the above numbers are not accurate but still show the numbers relative to each other.

6.4 General Perspective

IWMI, by the very broad nature of its current research mission, has expanded its traditional partner base and is now collaborating with a whole host of new partners in the areas of environment, health and sanitation. Its absorption of IBSRAM has also brought in a set of new partners in the areas of soil and land management. While most of these have been strategic, the Panel gathers that some partnerships have been more ad hoc and determined by the nature of the funding arrangements. The Panel particularly commends the partnerships in South Africa that have allowed IWMI an entry into the policy arena and influence into policy guidelines, and with the Ramsar Wetlands Convention, IUCN and the Nature Conservancy as part of the new and developing area of wetland management. Other relatively new key partnerships have been in the area of health and sanitation including collaboration with IRC and the Stockholm Environment Institute. Given that IWMI had very few partners in the period before 2000, the array of current partners is impressive.

6.5 IWMI's Decentralization and Building of Partnerships in the Regions/Countries

One of the key reasons for IWMI's research decentralization efforts has been to move researchers closer to their field activities and to be able to undertake country/region-specific research and ensure its uptake. The Panel sees this in the Africa program, with some key strategic partnering in Ethiopia, South Africa and Ghana where IWMI has made substantial investments in establishing offices. The India offices in Hyderabad and New Delhi have forged some useful partnerships though many are in a nascent stage, while the Anand office has built on the strong partnerships that already had been established by the Principal Scientist there. Indeed the partnership with the Sri Ratan Tata Trust has been key to some of the impressive work that has been done in India as documented in the CCER of IWMI-Tata Water Policy Research Program (WP94). This partnership is now in its second five year phase (2006-2010). The North-Gujarat Groundwater Initiative and the Central India Initiative are two examples within this overall partnership. The Southeast Asia office which has only recently moved from Bangkok to Penang

(with the WorldFish merger) has made a few inroads into making key and strategic partnerships especially with local universities and research institutes. The Panel feels that IWMI's intentions to decentralize its research operations is a good one and in line with the thinking of donors and others in the research and development arena worldwide.

With this strategy IWMI has been able to work in a wide range of countries and within these, with a wide array of national (and regional) partners. This kind of partnering, the Panel feels, has given IWMI the opportunity to define its ground research questions more thoroughly. However the Panel feels that with a few exceptions, there needs to be more effort at developing alliances dedicated to producing upstream knowledge. Indeed the real challenge for a decentralized research structure is to produce IPGs and these can only be done if there are strategic alliances made towards these ends.

IWMI has developed partnerships in this respect primarily through networks and programs, where IWMI often represents "tropical ecosystems" (or the South), i.e. the Global Water System Project of IGBP/HDGCP/Diversitas, PUB of IAHS, HELP of UNESCO as well as some partnerships in this category through the CPWF. For basin level results, IWMI has partnerships with several universities through their students. These have worked to varying degrees and not all have produced the intended results. We heard from several NARS that IWMI scientists have been instrumental in providing inputs into the reform process in South Africa on institutional issues ranging from WUA's to water laws and rights.

The South Africa partnerships as mentioned earlier are significant and strong and are cited here as the Panel was able to witness them first hand. These had the following key elements which made the partnership a positive one: 1) an appreciation by the partners of the senior IWMI staff who had stature and standing in the research field and as a consequence were included in high level agency meetings, in standing committees and for grant proposal screening; 2) an appreciation of specific disciplinary skills (in this case, social science) that IWMI brought to the partnership; 3) an appreciation of IWMI's international standing and perspective that introduced comparative views; 4) the perception that IWMI could be an 'honest broker' in situations that were contentious/sensitive (e.g. with the water allocation reforms); and 5) an appreciation that IWMI was in South Africa for the long haul.

In Hyderabad the interactions with government agencies were very cordial but not as strong though the current Head is working hard to improve the situation. It was noted that some of the NARs were not always fully aware of IWMI's research mandate, and in one situation, actually confused IWMI (the new entrant) with ICRISAT. To make the Regional Office concept work to its fullest, more effort needs to be put into developing key partnerships in country/region. But as remarked by one of the donors, IWMI tends to do better in countries where the agriculture research infrastructure is weaker. This may be the reason why true partnering with the NARS in India is somewhat harder whereas good and effective partnerships with NGOs are more evident.

6.6 Relationship with other CGIAR Centers

The Panel understands that there is a joint ICARDA/IWMI appointment in Central Asia, two WorldFish/IWMI joint appointments in Southeast Asia and another in South Asia. In addition ILRI and IWMI will appoint a joint scientist by the end of 2006. IWMI and IRRI continue to undertake the promising work on wet and dry irrigation. The relationship with WorldFish is an important and unique one and the two centers are beginning to cooperate in support services of HR, ICT and Finance. The Panel comments on this new corporate services structure in Chapter 8. The IWMI Hyderabad office is situated in the ICRISAT campus. By coming under the ICRISAT umbrella, IWMI is somewhat inured from the rather stringent Government of India rules and regulations and is able to have an office, receive

foreign funds and employ staff. In terms of program collaboration, ICRISAT senior researchers indicated that IWMI could do much more to collaborate and that the current India Head was far more receptive than the last in doing so. They also indicated that the ICRISAT and ILRI collaboration was an especially good one and hoped that IWMI would likewise engage in more joint projects. ICRISAT pointed to the IWMI upstream work (policies/institutions, basin level) and said that useful synergies can be created with ICRISAT's downstream work in the watersheds. The Panel endorses the view of ICRISAT senior management that IWMI, working on upstream issues can more effectively partner with ICRISAT working on downstream issues, to the mutual benefit of both.

The IFPRI-IWMI relationship has been a tenuous one in the recent past. Having started off as two joint appointments (for about three years), with IWMI covering about 25% of the salaries, the appointments have now been terminated. The work – before it encountered problems in expectations from the two Centers, generated some good outputs that were co-published and /or co-attributed by IFPRI and IWMI, most notably the book, Rosegrant, Cai and Cline (2002) *World Water and Food to 2005: Dealing with Scarcity*. The book has been highly acclaimed and also generated much media attention. The second major joint work involved the Water Impact Model – taking the IFPRI global IMPACT model of world food supply and demand and combining it with the IWMI PODIUM model. IWMI contributed the services of several scientists to work with the IFPRI researchers, with IWMI and IFPRI each responsible for a set of deliverables. Overall it seems that IWMI and IFPRI have their relative strengths (e.g. on the modeling work, IWMI is stronger on the hydrologic side while IFPRI is stronger on the economic models) but so far the collaboration has been difficult and now in fact has ceased. In discussion the Panel learnt that many of the lessons on joint appointments are common with other CGIAR centers also, especially when such appointments involved very senior staff with a strong public profile identified with one of the centers. This it seems creates problems of attribution and perceived division of labor that lead to discontent from the institution that is perceived to be secondary. It is also evident that now, far from collaboration, the two organizations seem to be in competition e.g. on work in the area of climate change. This is unfortunate because in terms of future collaboration, there seems to be real opportunity for joint work between IWMI and IFPRI in the areas of global water security and food security. There are also some areas in the past where collaboration has paid off – e.g. in water rights issues and gender (under CAPRI for example) and there have been joint events and publications. IFPRI continues to have a critical mass of researchers working in the areas of institutions, policy analysis and economic aspects of water management and it can also contribute to social science methods – all areas that are somewhat weak now at IWMI.

IWMI is actively involved and provides leadership to CGIAR system-wide programs such as the Consortium on Spatial Information, the Strategic Advisory Service on Human Resources (SASHR) program, the ICT-KM program, a shared Media position and the Gender and Diversity program. Other CGIAR DGs interviewed felt that there is a large role and niche for IWMI as the “traditional” agenda of irrigation investment in terms of large public investments appears to be re-surfacing. They reiterated the fact that future development of IWMI – as is the case for many of the CGIAR centers – is to work hard to position itself on a number of limited IPGs in an environment where more and more players are competing. Almost all of them commented on the success IWMI has had in a competitive environment, in more than doubling its size financially.

6.7 IWMI's Other Partners and Stakeholders

Overall the Panel is of the view that some partners work much more closely with IWMI and as such have been able to observe and comment more objectively (and sometimes more critically) on IWMI. Others have an “arms length” approach and in our interviews were only able to give a superficial commentary.

Unfortunately some of the bi-lateral donors and several of the government agencies fell into this category. Again, NGO involvement has been varied. Some like COSI in Sri Lanka have taken the lead and provide much of the staff expertise, while others are playing a minor role. Partners like the IUCN in Sri Lanka are keen to have research outcomes that they can use in their “extension” activities and spoke very positively about their collaboration. The Panel has understood that joint post-docs work more smoothly as they do not have to deal with the identity of the Center but only have to focus on the one project they are associated with.

By and large the NARS we spoke to have a favorable opinion of the Center. The situation in Sri Lanka is unique as the HQ's is situated in Colombo and the high expectations of the local NARS for involvement with IWMI are not always met and recent engagement is certainly not at the level it once was. There is the view that, as in the formative years of the Center, IWMI should be doing more field research in Sri Lanka and also making the effort to translate publications into the local languages. It has been particularly hard for the local government departments/ministries to understand the IPG nature of IWMI's work. The Panel was struck by the limited nature of communication with the Global Water Partnership which has funding from IWMI, particularly the South Asia Regional Water Partnership which is housed in the IWMI HQ building.

The Panel looked at the CGIAR PM Exercise Stakeholder Perceptions 2006: Center Report and noted that IWMI seemed to perform lower than average on most counts. Particularly striking was the score for fully and meaningfully involving its partners in important decision making and whether IWMI staff is responsive to the needs of partners and clients. In the light of IWMI's regionally decentralized structure, it was also striking that IWMI performed below average on the score for facilitating access of partners to the best available knowledge. The Panel also noted that IWMI was second from the bottom on the percentage of scientific papers per scientist that are published with developing country partners in refereed journals, conference and workshop proceedings in 2005.

In undertaking this review the issue of attribution has sometimes surfaced and it is not always clear how much of the outputs can be attributed to IWMI staff and their research and how much should be given to its partners. According to the Stakeholder Perceptions 2006 survey, IWMI was slightly below the average for the CGIAR Centers in the score for sharing credit for the success of projects with the partners involved.

IRD has a unique relationship with IWMI especially through its Southeast Asia office. IRD scientists have been deputed to work with IWMI in Laos and have taken over much of the role of IBSRAM in the previous era. The Panel was struck by the fact that: 1) IRD scientists and not IWMI staff were the majority of scientists working on the projects; 2) they were reporting to their research divisions in France, and their performance monitoring was also by IRD; 3) their research into land degradation was nothing new or exciting and raised serious methodological questions; and 4) the only social scientist attached to IRD was a post-doc working on a single independent study and social science inputs into the other research work was lacking. This kind of partnership – as evident with IRD – also brings up serious questions of IWMI building long-term capacity in the region. IWMI is only a five-year player in the region and needs to establish itself as a serious research organization in the region. IWMI has a very able and internationally recognized soil scientist as the Head/SEA – who is also able to manage the IRD relationship well - but he needs staff and resources to help establish IWMI in the region.

In looking at the documentation (Lessons Learned and Looking Ahead) in relation to the Global Dialogue on Water, Food and Environment, most partners felt that a lot had been achieved but that lots more

could have been done. A critical review of the structure for the Dialogue revealed that most partners felt it was too complex and broad and with unclear roles and responsibilities for each partner. Most of the Dialogue partners felt that there was weak ownership of the program as a whole; different visions sometimes in contradiction to each other, added to the problems.

6.8 The CGIAR Challenge Program on Water and Food

IWMI is host to two CGIAR System-Wide Initiatives, both of which have been considered in an earlier section. In addition the CGIAR Challenge Program (CPWF) is hosted by IWMI and is an international, multi-institutional research initiative with a strong emphasis on north-south and south-south partnerships. One of the major queries from partners outside IWMI has been whether there is a clear demarcation between IWMI and the CPWF. IWMI takes the view that there actually is little separation because the research question in System Priority 4, “increasing water productivity” is the same for both IWMI and the CPWF. However one clear difference is that while CPWF addresses the whole research question of how water productivity in agriculture can be increased, IWMI addresses only a select part of that broader question; for example, IWMI does not concern itself with the development of drought resistant varieties. IWMI believes that it has a clear and well defined niche at the basin scale where it conducts most research. IWMI currently has four benchmark basins and in addition works closely in six of the CPWF’s nine basins. In most cases, the IWMI research sites represent only parts of the basin, whereas the CPWF as a whole attempts to bring the results of research together at the basin scale and to monitor impacts of the knowledge generated through the program. The Panel believes this articulation of roles and responsibilities is sensible and should in theory result in complementarities and synergies, and less duplication of effort.⁴⁴ The Panel observes however, that IWMI research in other cases extended beyond a sub-basin focus. It also agrees with the comments of the SC that the Center’s most recent MTP provides more clarity regarding the linkages between IWMI and the CPWF—although there is still a need to articulate more fully the exact nature of CPWF’s links to IWMI’s new research framework and theme structure. Whether in fact these synergies actually emerge depends on how effectively IWMI and its partners cooperate. Some partners with whom the Panel spoke felt that the approach to implement research did not always ensure integration at the basin level. This is perhaps why the CPWF launched the Basin Focal Project (BFP) initiative to fill the gaps.

IWMI uses the CPWF as a primary vehicle for working with other partners and CGIAR Centers. These partnerships have been at times difficult. Many partners are not satisfied by the way in which the CPWF calls for and manages the (time consuming) competitive grant process. They have been very critical of the CPWF process and sees that it has been a vehicle for IWMI to get most of the resources and that the changes to the Steering Committee (where the current DG IWMI is the only one from the CGIAR Centers) has worked against it being an open decision making body.⁴⁵ Partners the Panel contacted also felt that partnering was too ambitious, creating large transaction costs and inevitably getting too many people involved for whom the CPWF is. However for example, the Panel understands that one of the BFP was developed by a few IWMI scientists with little consultation with others already working in the basin, thereby duplicating efforts. This BFP was further granted to IWMI with apparently no competition and its implementation caused confusion within the two original projects under implementation there. For example, the very fact that there was an anonymous letter of complaint that provoked an audit. There have also been a lot of “unfunded mandates” or meetings where project leaders have to attend for which they get no additional funds to cover their travel or time. As a result while the CPWF has resulted in a whole range of new partnerships, perceptions of IWMI and indeed of the CGIAR from these new partnerships have not always been positive. The latest communication from the CPWF Coordinator interrupting contract negotiations on the six winning bids – after people have revised and renegotiated with downstream partners - has now added to the strained relationships.

6.9 Host Country Relationship

The Panel understands that the overall relationship with the Sri Lanka government has had its fair share of difficulties. IWMI has also – wrongly – been the recipient of bad press in recent times. This has had more to do with the political agenda in Sri Lanka rather than with anything of IWMI's making. However the Panel wonders if IWMI management has made sufficient effort to try and redress this situation. The Panel does take note of the tsunami-related work that IWMI undertook to look at contamination of coastal aquifers and commends the support offered at a time of national disaster.

6.10 Training and Capacity Building

The Panel understands that the formal program of capacity building was launched in 2000 and included Policy Roundtables, PhD scholarship programs, NARS partnerships, a postdoctoral fellowship program, a private sector program and workshops.⁴⁶ The Capacity Building Program is administered by a Review Committee which meets three times a year for the purpose of reviewing applications for PhD support. The committee also nominates research supervisors for approved PhD students. The Panel questions the composition of the Review Committee and feels that drawing the committee from the Regional Directors does not give it the needed disciplinary breadth. Rather the Panel strongly suggests that a discipline – driven committee made up of the Principal Scientists recommended as the theme leaders (see Chapter 5), be instituted as the Review Committee. The Center has carried out about 50 workshops per year on average on a wide variety of themes specific to the needs of its partners and its own mission. With the start of the CGIAR Global Food and Agriculture University, IWMI is involved in developing course material for distance learning at the Masters level on irrigation and water management. We note from the documentation given to us that Policy Roundtables have not happened in 2005 and 2006 and wonder if this confirms the Panel's view that less efforts are now being made on the upstream activities.

The Panel gathered from interviews with selected IWMI partners that some of the most important results in capacity building have come from informal relationships between IWMI senior staff and the institutions and networks they work within the regions. The input of senior social scientists to the water reform process in South Africa is considered to be one such good example. A major priority for IWMI is to partner with the NARS to enable scaling up through targeted institutional capacity development. The general decline in the capacity of the NARS combined with IWMI's spread of institutional partners may have diverted attention from many. These have been identified to be roundtable discussions at the highest possible level, using high-profile internationally known persons. The target is 2-3 per year of the NARS. In the materials presented to the Panel, only a few examples of capacity strengthening involving the NARS were noted.

The Panel has noted that in the list of IWMI-associated universities, many are second tier and regional universities. The Panel further observes that there is very little effort to get faculty to come to IWMI on a sabbatical or other short term leave. The Panel feels that the association with PhD students can sometimes work well and points to the example in Ethiopia with Cornell University.⁴⁷ However the Panel feels that not all PhD and MSc students get adequate mentoring and are often attached to an IWMI research project with little supervision.

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Only one formal recommendation was placed under the heading of “Partnerships and capacity Building” (recommendation#11) which, in fact, addresses essentially the capacity building component, but other Recommendations are also touching upon other elements of partnerships R2,R5,R10):

“Recommendation 11. The Panel recommends that ICRISAT reorganize the structure and oversight of training and capacity building, and develop output quality criteria, as well as explicit expectations for mentoring and supervising research scholars, research fellows, and interns by ICRISAT scientists.

Response by the Center: **Accepted.** We will restructure and enhance the quality of our training and capacity building initiatives by developing performance and output indicators, fortifying consistency in selecting, mentoring and overseeing scholars and training participants and improving the mentoring capacity of our scientists. ICRISAT sees a particular need for an emphasis on SSA, and believes this should be a system-wide CGIAR priority.

Recommendation 2. The Panel recommends that ICRISAT take ownership of and celebrate the strategic planning and research prioritization process based on: (i) proactive engagement of staff, Board, stakeholders, partners, and donors; (ii) analysis and understanding of recent crop yield and production trends, and projected growth in production and demand for its mandate crops, (iii) scenario analyses that utilizes geospatial analysis, ecosystem and crop modeling, and an appropriate socioeconomic framework.

Response by the Center: **Accepted.** Through a redesigned and revitalized strategic planning and priority setting process, the Governing Board and ICRISAT will effectively respond to the priorities of stakeholders for the sustainable development of semi-arid agriculture. Towards this, we will develop and implement a knowledge-based process that is inclusive, seeking inputs from key partners and stakeholders, more systematic and more explicit. This will build on our achievements, partnerships and comparative advantages in improving agricultural systems in the semi-arid tropics.

Recommendation 5. The Panel recommends that GT-IMPI (Institutions, markets, policy and impacts) work on the development of hypotheses that determine the IPG potential of ICRISAT’s downstream work on technology development, testing and adaptation.

Response by the Center: **Accepted.** Using impact assessment and other tools, ICRISAT will identify lessons and testable hypotheses that offer new insights to facilitate scaling up of technologies. We will implement this through wider dialogues among scientists across research themes and locations and with partners, including donors to demonstrate that our impact-oriented downstream work leads to IPGs.

Recommendation 10. The Panel recommends that ICRISAT move rapidly to de-emphasize current mature lines of work, particularly in GT-AE (Agro-ecosystems) e.g. watershed management in Asia, microdosing, Africa market gardens, dryland eco-farms), and work that can be performed by the NARS (e.g. jatropha, pongamia, chickpea in rice fallow systems) to free up resources needed for new initiatives.

Response by the Center: **Accepted.** ICRISAT will adopt a nuanced approach in implementing this recommendation, guided by: (1) the availability and strengths of NARS and development-oriented partners, (2) need to provide technical support for such devolution, and (3) extent of remaining research issues for which ICRISAT has a comparative advantage.”

One of the major issues the EPMR was supposed to address is on the appropriate balance of ICRISAT investment between Asia and SSA. As a follow up on two recommendations of the former EPMR (5th EPMR) recommendation #5 to phase out the GT3 (water, soil and agrobiodiversity management) research in Asia where it has no longer a comparative advantage, by devolving this research to NARS and redeploying resources to SSA; and recommendation #9 to restructure ICRISAT programs and transfer its headquarters and all programs in SSA except its strategic plant genetic resources enhancement program.

The question posed to the Panel was articulated as follows:

“Following the 5th EPR, what are the major changes in ICRISAT’s governance, management, research approach, resources and research agenda to tackle research for development challenges in sub-Saharan Africa in general and with respect to the current food crisis in particular? Does the Board have appropriate procedures and information to strategically decide on resource allocation between Asia and SSA?”

The answer is articulated in the Executive Summary:

“The fundamental question is whether ICRISAT can effectively and efficiently serve less developed SAT regions from its headquarters in India. Based on logistics, cost, and the capacity for spillover from upstream research, the EPMR panel agrees with ICRISAT and believes that headquarters should remain at Patancheru for the foreseeable future with the following provisos: **The Panel recommends that ICRISAT continue to enhance investments in personnel and infrastructure in the SSA and use the potential for spillover to SSA as one of the explicit criteria used in prioritization of strategic investments in research conducted at the Patancheru headquarters.**”

Additionally, in its commentary on the Governance, management and finance aspects of the EPMR, the CG Secretariat pointed to a dimension of partnerships which has been overlooked by the Panel.

Partnerships and Capacity Building

“Recommendation 11 touches upon partnerships and capacity building. The CGIAR Secretariat concurs with the Panel in recognizing the strength of ICRISAT research teams compared to researchers in many universities and NARS in the semi arid tropics and the resulting responsibility of the center in capacity building. It applauds the Center’s response to this recommendation which supports capacity building as an overarching priority in Sub-Saharan Africa (SSA) for the Center and the CGIAR system as a whole. The substantial involvement of ICRISAT in mentoring M Sc and PhD candidates as well as interns and research fellows, and in organizing a number of training workshops in Asia is particularly acknowledged. However, the CGIAR Secretariat is concerned about the finding that despite the availability of performance measurement system data on publications, the uneven quality of data collected on training constrained the Panel in looking at another dimension of publications related to assessing capacity building and partnerships. Analyzing the number of SCI articles, journals and books co-authored with NARS, ARIs and other partners would have given a useful indication of the impact of ICRISAT’s capacity building programs on NARS strengthening and collaboration with partners, particularly in SSA.”

Excerpts of the Report

5. Partnerships and capacity building

5.1 Partnerships

5.1.1 Introduction

“In ICRISAT’s strategy to 2015, the Center’s vision is stated simply as the improved well-being of the poor in the semi-arid tropics. Throughout the 6th EPMR, the Panel noted the size of ICRISAT’s mandate and the relatively modest resources available to achieve it. This does not make the vision or the mandate unreasonable or unrealistic; it does place a special burden on ICRISAT to be strategic in setting goals and in deploying its resources. Among the most critical of these resources is the Center’s ability to use the quality and relevance of its work, its reputation, and its management capacity to build partnerships.

ICRISAT has a strategic grasp of where partnerships add value and has defined the span of potential partners in a thoughtful, pragmatic way. These partnerships are both internal, involving CGIAR Centers (IARCs) and the challenge programs, and external, engaging the NARS, ARIs, private sector, civil society groups, NGOs, communities and farmer groups.

The evaluation of each of ICRISAT’s global themes and the VASAT (Virtual Academy for Semi-Arid Tropics) project (Chapter 4) includes pertinent assessments of the nature, intent and quality of partnerships for a range of specific research activities. This section looks more broadly at partnerships in terms of their strategic value in advancing the Center’s mission and vision, and in contributing to capacity building. It also considers in more detail the partnerships ICRISAT has with IARCs and through the challenge programs. The Panel believes the Center’s general ability to form good partnerships is critical, but that, in the face of prospective changes within the CGIAR System, positive partnerships with those in the System are likely to be predictive of a center’s ability to develop and contribute to competitive multi-partner, multi-year mega-projects.”

5.1.2 Partnerships with Institutions outside the CGIAR

“In addition to using partnerships to leverage and disseminate its work, the Center sees partnerships spurring cutting edge research as well as assuring that research is demand driven and well targeted. While this is evident in many of its partnerships, it is particularly evident in the work undertaken with the private sector. In this area, where the Center has been notably active, public good is generally well balanced with the motivations of private enterprise. In fact, ICRISAT appreciates the extent to which these partnerships introduce business discipline and redistribute the risks associated with moving knowledge and innovation into the public domain. The Panel considered ICRISAT’s substantial experience collaborating with the private sector and in realizing financial support from it through these partnerships to be positive. It also concluded that the experience offers some cautionary lessons that ICRISAT should acknowledge and learn from (Chapter 6).

ICRISAT reports 190 organizations as partners and collaborators. This encompasses not just a significant span of partners but also partnerships of differing intensity and duration. ICRISAT’s relationship with the host country, India, is a good illustration of the value of a partnership developed along many dimensions. A track record of good work undertaken with national and local governments, the NARS and Indian research institutions has created trust, credibility and good will and strengthened relations with the host country. This has yielded not only increased investments by India in the Center but also access to a network of individuals and organizations that can benefit each of ICRISAT’s research themes and its work in SSA. Benefits are considered to flow two ways; NCAP, an advanced research institute in India, expressed great appreciation for its linkages with ICRISAT, noting professional contact with the Center’s staff and access through ICRISAT to the international community. Comparable

sentiments were expressed to EPMR Panel members by representatives of the National Research Center for Plant Biotechnology (NPCPB), and CAZRI (Central Arid Zone Research Institute).

Among the global themes, GT-IMPI has played a strong role in both working with partners in its principal research areas and in facilitating partnerships involving work in all three regions and other global themes. The Center's approach to partnerships is exemplified by GT-IMPI (Institutions, Markets, Policy and Impacts), and GTCI's (crop improvement) seed systems work (the West Africa Seed Alliance), which brings a number of the Center's staff and programs together with a diverse group of organizations to help develop a competitive seeds industry. The seed systems project is now extending to ESA. It is also being increasingly integrated with the work of relief organizations interested in giving seed supply efforts a more permanent operating platform, rather than being ad hoc responses to severe drought and other crises. The Panel considered this particular set of projects and partnerships a good illustration of the extent to which ICRISAT's purposes and strategy for partnerships are shaped and prioritized by regional considerations. Unlike India where both the NARS and the private sector play effective roles in hybrid seed development and distribution, many NARS and the private sector in SSA are not sufficiently developed to do this.

Partnerships have also benefited the Center's work in crop improvement, biotechnology and knowledge management through linkages with major research universities in the U.S., Europe, Asia and SSA, and strong and improving working relationships with national governments and regional research organizations and coordinating entities in Africa.

It is worth noting that the stakeholder survey did not reveal any significant problems with ICRISAT duplicating work done elsewhere or crowding out NARS and other partners. During field visits, Panel members did receive feedback from a number of sources that partners wish to be consulted earlier in project planning and resource development in order to be able to have their experience and perspective valued at as early a point in the planning process (and during subsequent iterations) as possible."

5.1.3 Partnerships with CGIAR Centers and the Challenge Programs CGIAR Centers (IARCs)

CG Centers

"The EPMR solicited feedback from each of the directors general of the IARCS (15) and received responses from eight. The Centers were asked to address questions relating to ICRISAT's research priorities, the quality of the collaborations, whether the Center is a good partner, and the potential for future collaborations. The feedback reflected experiences with ICRISAT that spanned the five year period of the review, a period during which the Center was highly focused on re-gaining its financial footing, decentralizing its programs and management, and aligning its priorities with those for the system as a whole. The Panel appreciates that a Center that worked with ICRISAT in the first years of the turnaround may have a different, less positive view of ICRISAT as a partner than Centers with collaborations undertaken in the last few years. With this in mind, the Panel believes that the Center is undoubtedly a better partner today than it might have been in the recent past. The feedback also uncovered a common dilemma when Centers have overlapping environmental and crop mandates, and projects sit side by side in common geographic locations. There is clearly a potential for periodic "jostling" among Centers for the right to engage in a particular activity or to lead projects where "ownership" can be claimed by others. ICRISAT was taken to task by a number of directors for crossing boundaries. This could probably be said of the reciprocating Center. It was also criticized for periodically taking on more than it could deliver.

As the Center has rebuilt its financial position, increased its research staff and established good leadership for WCA and ESA, the Panel believes the ability to deliver and the consistency of results will improve. A number of the Centers indicated an interest in working collaboratively with ICRISAT on new projects, based on recent experiences and also a perception of ICRISAT as a strong partner. Certainly, its recent projects with ILRI on crop/livestock interactions indicate the potential quality and mutuality of the Center's inter-Center partnerships going forward.

Challenge programs

ICRISAT has been involved in the first three CGIAR Challenge Programs since their inception in 2004. The Center has played a role in HarvestPlus, Generation, and the Water and Food challenge programs, either as a consortium member (GCP) or through commissioned competitive projects (H+ CP and WFCP). It has some involvement in one of the sub-Saharan CP (SSA CP) learning sites.

The level of funding ICRISAT receives from challenge programs has increased from USD 932,000 in 2004 to an estimated expenditure of USD 2.3 in 2008 (Table 5.1).

CP	2004	2005	2006	2007	2008a
GCP	0.542	0.497	0.570	0.759	2.357
H+ P	0.258	0.319	0.302	0.306	0.213
WFCP	0.132	0.776	0.945	0.751	0.765
SSACP	0	0	0	0	0.062
Total	0.932	1.592	1.817	1.816	3.397

Table 5.1 Funding levels for ICRISAT projects under the CPs

Source: ICRISAT Audited financials (2004-2007); a Estimate

The GCP has 22 partners; and ICRISAT is second behind IRRI in GCP funding. One of the GCP sub-program leaders has a 0.50 FTE appointment as an ICRISAT staff and is located at the Center's headquarters. The level of GCP fund remained in the range of USD 500,000 to 600,000 from 2004 through 2007, but is projected to double in 2008 as a result of its role of the GCP's tropical legumes project funded by BMGF. GCP funding to ICRISAT has focused on research on sorghum drought tolerance in SSA; groundnut wild relatives; bioinformatics tools (LIMS and iMAS), molecular characterization of sorghum, pearl millet, finger millet, chickpea, groundnut and pigeon pea; and capacity building. GCP is a 10 year program that ends in 2013. Funds for the program are projected to fall rapidly after 2009. As the GCP winds down, it is important for ICRISAT to develop a plan to secure funding to continue those aspects of its GCP research consistent with the Center's research priorities and strategic plans.

For HarvestPlus, ICRISAT has collaborated on micronutrient biofortification of four of its mandate crops (sorghum, millet, groundnut and pigeonpea). Part of the program's funding has gone to upgrade ICRISAT's analytical capacity for micronutrients. Research for improving iron and zinc content of pearl millet is centered at ICRISAT and has progressed rapidly with a high iron/zinc variety planned for official

release in 2011. However, donor pressure to focus the CP in fewer crops may lead to reduced work on sorghum, pigeon pea and groundnut.

In terms of project funding, ICRISAT's involvement in the Water and Food Challenge Program has been the most notable. WFCP-funded research is located mostly within GT-AE, but in 2004-2005 also within GT-IMPI, GT-CI (crop improvement) and GT-BT (biotechnology). ICRISAT is not a consortium partner, but derives its support from competitive projects it applied for and received. It is involved in the WFCPs crop-water productivity program and leads two projects in WCA and ESA for which it received a significant grant.

The EPMR solicited feedback from the three challenge programs in which ICRISAT participates. Observations ranged from information that was useful but tactical or technical in nature to information that the Panel considered important for ICRISAT to incorporate in future project planning. Among the latter were comments relating to the Center's tendency to be optimistic in stating its abilities and capacities. ICRISAT is not considered alone among Centers in doing this, but the suggestion that ICRISAT be more cautious and realistic in these matters is worth heeding to ensure being seen as a credible partner. The other feedback the Panel wishes to share involves the need to identify good staff leadership for projects from the start. A project that involves significant funding and multiple partners needs to begin well and strong research and management talent is the minimum starting point."

5.1.4 Assessment

"During the period of the review, ICRISAT's work with partners appears to have strengthened. The range and standing of partners also appears to be strong. The Panel believes that the Center has been particularly enterprising in exploring the potential of the private sector to be valuable partners in advancing the mission of centers like ICRISAT.

In its efforts to move IPGs downstream to farmers and others, partnerships play a critical role. In this regard NARs remain the Center's most important partners, but pose the greatest challenge because of the variability of institutional capacity among them. While ICRISAT works to enhance the capacity of NARs and extension activities through training, fellowships and support for post-doctoral candidates, informal capacity building also occurs as collaborative projects are planned and implemented. In addition to its work with NARs, ICRISAT has developed complementary partnerships with civil society organizations, farmer groups, and development agencies that facilitate the downstream impact of ICRISAT's research. The Panel's site visits in India and Africa confirmed the extent of these partnerships and their contributions to ICRISAT's goals in partnering and capacity building.

The Panel considers the strategy that ICRISAT has identified to guide its work with partners a good beginning but that it needs to be implemented more systematically and supported by a stronger framework for project planning and prioritization. Good partners are an asset; poorly identified partners can result in loss of time and, ultimately, capacity to deliver impact.

As the Center's restricted funding grows and the size of grants increases, partnership is a central strategy for delivering results. The Center needs to be attentive to its experience with challenge programs and attentive to the assessment of its partners and colleagues in these programs. This is a large part of ICRISAT's future success and the Center must take this opportunity to improve its performance in this arena."

5.2 Training and Capacity building

5.2.1 Nature and Scope of Individual Training Activities at ICRISAT

“ICRISAT and its staff invest considerable efforts in a variety of capacity building activities. These include distance outreach to change agents and farmers (VASAT, LSU’s e-learning material), training courses on particular topics for groups of participants, the capacity building inherent in research partnerships, and individual training activities. The recipients of the last fall into three categories:

- Research scholars—MSc and PhD candidates who conduct the research component of their thesis at ICRISAT. The mentoring of this research is shared between a Center staff member and a scholar’s university.
- Research fellows—mid-career scientists from the NARS who spend up to one year at the Center and are mentored by a member of staff.
- Interns—undergraduate students who acquire practical work/study experience at the Center. Often, this work counts towards the award of an intern’s first degree, and mentoring arrangements between ICRISAT and the intern’s university apply.

One challenge the Panel faced in evaluating training and capacity building was incomplete, out of date or conflicting reporting on training activities. The fact that intern and research fellow data did not discriminate with regard to short or longer-term training (from a visit of 2 days to over a year for interns and about 9 months for research fellows) presented a particular complication for the assessment.”

5.2.2 Training Output

“In its assessment the Panel considered the trainees according to the relative length of their stay at the Center (less or longer than 3 months; Table 5.2). The Panel viewed these categories of trainees and the time factor useful indicators in assessing the output and quality of training activities. Out of the 182 trainees registered as research fellows, only 32 (21%) stayed longer than 3 months; only 6 stayed longer than 6 months. The Panel believes that the mid-career research training characteristic of research fellows must be long enough to provide an opportunity for a meaningful expansion of knowledge and experience and to build a mentoring relationship with a supervisor. A period of less than 3 months does not seem adequate.

Type of training	2003	2004	2005	2006	2007	2008a	Total	% Women
Intern (≥3 m)78	42	71	42	70	30	333	52	
Research Fellow (≥3 m)	8	7	4	8	5	32	47	
Research Scholar, all	11	8	19	11	25	12	86	43
Total	97	57	94	61	100	42	451	50
“Short-term” interns	43	41	8	58	37	22	249	41
“Short term” res. fellows	64	66	87	80	65	39	401	40
(a Data set is not complete for 2008)								

Table 5.2 Number of individual trainees by type, 2003-2008

About half the interns (250) stayed less than 3 months. Of those at the Center for short periods a third received specific technical or skill training on such things as the library, computing, and farm machinery, for instance, rather than research-oriented training. The Panel believes that technical or skill-related training is fundamentally different from research-oriented training and should not be combined for reporting purposes.

Among the trainees with ICRISAT for longer than 3 months, 50% were women; a slightly larger proportion of interns were women than fellows or scholars. This level of participation by women in these training activities is commendable. This contrasts with the low number of women in short-term training courses (only 16%). The participation of women in this level is often heavily affected by the rate at which their institutions nominate them to attend the courses.

ICRISAT has trained individuals from some 40 countries, the majority (81%) from India (Table 5.3). This is particularly the case with research scholars and interns. Research fellows have a more diverse nationality background. Twelve percent of the trainees came from developed countries, which the Panel considers positive. The chart makes clear the inequality across all categories between Asia and Africa. Distance from Asia and a lack of resources may provide reasons for the small number of African participants in training programs, but the Panel believes the Center must find ways to address this by increasing opportunities in Africa as well as in India, particularly for research fellows and scholars from Africa.”

Type of trainee	Africa	India	Asia (w/o India)	Developed countries
Intern	2	86	3	12
Research Fellow	16	28	12	16
Research Scholar	3	80	1	14
Total	3	81	4	12
Short-term trainees	6	66	13	11

Table 5.3 Regional and national origin of individual trainees

5.2.3 Quality of Research Scholar Training

“The Panel attempted to evaluate the quality of Research scholars based on the publications derived from theses. The source data was a list of publications provided by the Center organized by research scholar. The list included 50 individuals who had been degree students at ICRISAT since 2000. Half of the 50 had studied biotechnology; most of the balance had studied crop improvement. There was only one social science and one NRM scholar among the group. Information for the 50 scholars was incomplete. Of 34 for whom information was available, 25 (74%) were PhD students and the rest were MSc students. Out of these, 20 showed that the thesis was published 0-6 years after the stay at ICRISAT (on average 2.3 years later).

Of the 50, 34 had published—a total of 34 SCI journal articles and 39 non-SCI articles and other publications (excluding their degree thesis). Twenty scholars had published at least one SCI journal article. The rate of publication is influenced by the time from completion of study and the thesis, but it is reasonable to expect that a thesis should lead to at least 2 high quality journal publications where the student is the first author. ICRISAT graduate trainees fall far from standard. Eighteen (36%) had no publications other than the thesis. In one third of the publications the research scholar was not the first author; however these publications may not have derived from the thesis. The Panel recognizes that publication expectations of the host university have a large influence on student’s publication productivity, but it would like to see ICRISAT work to improve the publication output of research scholars who spend significant time at the Center. The Center should also systematically request its

graduate alumni to inform it on any publications that have been published based on research conducted at the Center.”

5.2.4 Responses by ICRISAT to CCER Recommendations

“The KMS (knowledge Management and Sharing) CCER recommended that ICRISAT review its investment in individual capacity building activities, compile information on trainee distribution, current selection practices, supervision procedures, IPR protection and costs and benefits to ICRISAT of these activities. The overall objective was to provide a strong basis for documenting the Center’s contribution to capacity-building IPGs and developing a more consistent Center-wide set of procedures and policies. The EPMR Panel fully endorses this recommendation and would go further in suggesting that the Center identify an experienced senior scientist to oversee Center-wide capacity building, clarify expectations for mentoring and supervision, and develop quality targets for training, particularly with respect to research scholars. The Panel was informed that the report of a sub-committee of the Research Committee charged with conducting an internal review guided by the CCER recommendation was accepted in April 2007. Since then, however, the status of implementing the recommendation was not clear to the Panel. Based on the quality of data provided to the EPMR Panel, the starting point for the internal review may have been less favorable than assessed in the CCER. The Panel concludes that the Center response to the CCER recommendations is not satisfactory, and believes that the Center would benefit greatly from taking a thorough and probing look at maximizing its investment in training for its benefit as well as for the benefit of the fellows, scholars and interns involved.”

5.2.5 Assessment

“ICRISAT has the potential to leverage its scientific expertise, facilities and access to funding for training in a manner that is considerably more powerful than available at most universities in the SAT. The Center can offer to interns, research scholars and research fellows strong links to current science and exposure to a market place of ideas and the habit of continuous learning. Interns working on Center research projects often gain their very first exposure to scientific research and development at ICRISAT. If ICRISAT can contribute, in proportion to its comparative advantages, to attract young undergraduates, produce truly inquisitive, able and committed PhD and MSc graduates, and enlarge the perspectives of its research fellows, it will have a huge impact on the NARS and universities in the SAT, and produce important Pig’s. The Panel met some impressive ICRISAT research-fellow alumni in India (e.g., Dr. Yadav at CAZRI, Dr. Joshi at NCAP) and in the African NARS. Research scholars interviewed at Niamey and Patancheru believed that ICRISAT successfully taps significant pools of local talent. By and large, university partners interviewed by the Panel hold ICRISAT in high regard. Commenting on ICRISAT’s capacity building, NARS and NGOs in both Asia and Africa were uniformly complimentary about the Center’s training courses and expressed a wish for greater access to them. Of the stakeholder respondents, a majority (48%) assessed ICRISAT’s capacity building as good; 17% considered this activity excellent. Taken together, all these indicators suggest that ICRISAT is doing a very good job in the capacity building domain.

It is within this positive context that the Panel considers it important that ICRISAT raise expectations and improve its internal procedures and practices with respect to scholars, fellows and interns. The overlapping responsibilities for training between LSU and HR need to be clarified, and a better process for administering and tracking training activities and participants is important to implement. More important, participants in the scholar, fellow and intern programs need to have goals that enable them to maximize their experience with ICRISAT. This includes expectations about minimum time commitments and research productivity.

It is not unreasonable for ICRISAT to expect that those it accepts to its training programs will establish and work to fulfill goals for publishing. This suggestion is not an effort to encroach on the role of a trainee's university but to communicate to prospective training candidates ICRISAT's commitment to quality research. It is also important for ICRISAT to establish a stronger framework for the role of research scientists as mentors and colleagues to those in the training program, establishing procedures for accepting scholars and benchmarks for the number of scholars and fellows to be supervised at any one time. Training and capacity building need due recognition as part of the outputs and achievements of the Institute. Structuring the program to achieve IPGs and communicating achievements will build broader recognition for this function and ICRISAT's contributions to donors and partners may help in this effort.

The Panel recommends that ICRISAT reorganize the structure and oversight of training and capacity building, and develop output quality criteria, as well as explicit expectations for mentoring and supervising research scholars, research fellows, and interns by ICRISAT scientists."

E. IRRI 7th EPMR, February 2009

The report does provide looked at IRRI's partnerships, engaging partners in networks and consortia, roles and relationships with NARs, Relations with the CGIAR(?), Relations with ARIs, and Relations with the Private Sector (Chapter 4).

Two recommendations formally addressed partnerships issues:

Recommendation 3: Africa. The Panel recommends that without delay IRRI, with WARDA, establish an East and Southern Africa Regional office and a fully supported multidisciplinary research team in Tanzania; that it engages with Madagascar's NARS, and develops partnerships with key institutions in ESA, especially in the seed sector.

Recommendation 7: Managing Country Partnerships. The Panel recommends that IRRI better define its strategy and objectives for country and regional programs, and that the mandate and functions of the International Programs Management Office (IPMO) be clarified to support these objectives.

The Report Summary states the following on Partnerships:

"IRRI's partnerships are broader and more complex than in the past. Many traditional NARS partners are growing stronger and some, such as China and India, have capacities that require IRRI to re-examine its own comparative advantage in rice research. In addition, IRRI increasingly interacts with other CGIAR Centers, advanced research institutes (ARIs), and the private sector. One important strategy has been IRRI's use of consortia to focus interaction on specific areas of research, to build NARS capacities, and to increasingly assign responsibilities to local partners. Several of these consortia have a long history and have led to significant technological innovation; several new consortia offer considerable promise for extending these gains. Nevertheless, a more comprehensive approach to NARS partners is required. The heterogeneity of Asian NARS makes it impossible to define a common strategy, but IRRI's interactions with NARS deserve particular attention."

Chapter 4. IRRI'S PARTNERSHIPS

In the rice research and development world of today, in contrast to the 1960s when IRRI was formed, there are many more players having an increased diversity of goals. Critical partners in research at that

time were NARS, and relatively few Universities in Asia and industrialized countries. Seed production was managed mainly by public seed organizations, and extension was largely through Government agencies. Today the NARS still play an essential role, but there is a plethora of ARIs who are also engaged in rice research, in many cases not as a crop but rather as a genomics model. Other IARCs are active partners in addressing the needs of rice based cropping systems. Governmental extension services have been sharply reduced, and some of that role has been taken by a diverse group of NGOs and, increasingly, the private sector. Traditional communications media of radio and television are being replaced by the internet and by cell phone technology. The role of governments in seed dissemination has diminished, but in their place is a rapidly diversifying private seed industry. Roles in partnerships have also changed. Large NARS, such as China and India, have research and national development programs of increasing scope which may share germplasm and are able to commission research. Donors in general have increasingly focused on supporting specific aspects of research work rather than supporting an institution per se. For these reasons the nature and health of these multiple relationships are of growing importance to IRRI as it fulfils its mission.

4.1 Engaging partners: Networks and consortia

IRRI's primary direct clients are the NARS of target countries. Public (and increasingly private) organizations of the national research systems adapt IRRI's products of improved rice germplasm, crop management technologies, and knowledge about the rice crop into components suitable for farmer' circumstances, and ensure these are transferred to farmers. Exchanges between individual scientists in NARS and at IRRI, through visits and training, have formed a strong basis for personal research partnerships, and will continue to be a very important factor driving collaboration. As national research programs have strengthened, relationships between IRRI and NARS have assumed a more democratic basis as consortia of various types have developed. In most consortia, an IRRI IRS functions part-time as the facilitator, but involves NARS in much of the decision making. In some instances leading NARS have been providers of technology to IRRI and to other consortium partners. While NARS are quick to acknowledge the very considerable contributions of IRRI, they also desire recognition and credit for their contributions.

The design of appropriate technologies requires that the Institute responds to real farmer needs. It is important that the flow of information to IRRI scientists - informing them accurately of farmer circumstances - forms part of an information loop that is used to identify appropriate technologies and to fine tune them during the experimentation and testing phases. Over the past decade, IRRI has continued to move upstream in the research continuum, and budget constraints have placed limits on direct interaction with NARS. Thus the need for accurate understanding of farmer circumstances as they change is perhaps even more acute today than a decade ago. IRRI has initiated a series of networks and consortia to serve as a vehicle for sharing germplasm and generating and testing production technology. A complete list of these is given in Annex 6 and reference has already been made previously to the research functions of the most important of these. The focus in this chapter is less on their research agendas and more on the effectiveness in servicing partnerships.

The International Network for Genetic Evaluation of Rice (INGER)

INGER's goals are to share global genetic resources with all rice scientists. Numbers of participating countries have fallen from 85 countries at its peak to 39 today, and only about 45% of nurseries return data. Weaker NARS cannot always afford to run the trials, and some germplasm distributed is poorly adapted and of less interest to NARS that want finished varieties. INGER trials also declined in popularity because of an unwillingness by NARS (following the adoption of the Convention on Biological Diversity) to share germplasm because of IP concerns, and a lack of feedback of data to NARS. IRRI breeders also

complain that data comes too late to influence breeding decisions. Recent changes in data entry procedures and the use of the SMTA with germplasm transfer have increased confidence and INGER's popularity, and it appears that INGER will continue to provide a useful service to the rice breeding community. The Panel, however, does not think that INGER is the best vehicle for distributing replicated yield trials, preferring instead the development of a carefully designed multi-location testing network with clear breeding goals.

Irrigated Rice Research Consortium (IRRC)

Now in its 12th year, IRRC focuses on improving irrigated rice production practices at sites in its 11 partner countries in Asia. Its objectives are to validate innovative resource conserving and post-harvest technologies for lowland irrigated rice, and to facilitate their adoption. Its research addresses efficient nutrient and water use, pest management and IPM with special attention to the environment and to sociological factors. IRRC participating scientists meet annually to exchange results and plan joint research projects. However, the Panel notes that IRRC does not evaluate varieties.

Consortium for Unfavorable Rice Environments (CURE)

This network, created in 2002 as a successor to the Rainfed Lowland Rice Research Consortium (1992) and functioning in 10 countries, focuses on low yielding, rainfed lowland and upland rice farming systems where yields are often unstable because of abiotic stresses. CURE develops the consortium concept further by moving control of the network to the NARS. This consortium does include limited comparisons of varieties, mostly carrying SUB1, SALTOL or QTLs for drought tolerance. There is institutional investment by the NARS at each research site, and the network provides funds for each trial. A key component is participatory variety selection (PVS) by farmers. It is encouraging that some CURE sites are already being used for germplasm evaluation by the Rainfed Lowland Breeding Program.

Rice-Wheat Consortium for the Indo-Gangetic Plains (RWC)

The Rice-Wheat Consortium for the Indo-Gangetic Plains (IGP) includes as its principal members the national agricultural research systems of Bangladesh, India, Nepal, and Pakistan and several IARCs (principally CIMMYT and IRRI, with smaller contributions from ICRISAT, ILRI, CIP and IWMI), several ARIs, and the private sector in the IGP. It is currently convened by IRRI but managed by NARS. Its main goal is to develop and deploy more productive and sustainable technologies for areas dominated by the rice-wheat crop rotation by using research partnerships among members. Especially impressive are the linkages between the RWC and private machinery manufacturers that have led to a major increase in direct seeded, zero-tilled wheat.

Other equally important partnerships are those between Universities and the RWC. Much of the research undertaken by the RWC will be subsumed under the new CSISA project that plans to use a number of RWC research sites. The Panel is pleased with this donor endorsement of the very considerable accomplishments of the RWC, but suggests that the consortium remain in existence throughout the life of CSISA.

IRRI has a number of other consortia and networks, but space precludes a full description (see however Annex 6). Their principles of operation are broadly similar to the consortia described above.

Panel Assessment: Consortia and transfer of research capacity

The establishment of consortia by IRRI has been an important means of strengthening NARS in Asia. These have generated a high level of collaboration among members, and have helped expand the research capacity of NARS. The exploitation of interactions between variety and resource-conserving

management practices will be an important step forward, and one that IRRI should seriously consider. Consortia have played a significant role in the transfer of some of IRRI's research functions to NARS. One example is the continued development and extension of resource-conserving technologies such as site-specific nutrient management and alternate wetting and drying methods that have been transferred to IRRC member countries through the consortium. The generation of direct seeding techniques under the RWC is a further example of growing NARS research and private sector strength in the IGP region. Finally, the development of country-specific rice knowledge banks based on IRRI's pioneering version is a further indication of transfer of function from IRRI to NARS. The Panel regards these and other examples as evidence that IRRI's strategy for developing partnerships with national programs through networks and consortia is enabling and empowering NARS scientists, and increasing the capacity of NARS to fulfil their mandates.

4.2 Roles and relationships with NARS

IRRI enters into a range of relationships with its different NARS partners. Traditionally IRRI has been a provider – of training, germplasm and technical advice – and NARS officials are consistently appreciative for the type of support that has been available. But the nature of NARS is changing, and the concomitant partnerships must also evolve. Many NARS are now linked (to each other and to IRRI) through networks for germplasm testing or for site-specific technology generation. NARS are anxious that these be treated as true partnerships and do not want to find that IRRI is merely using them as a means of collecting data. In other cases, particularly with advanced NARS such as China, it is necessary to identify the comparative advantages of the respective partners and to urge NARS with specialist capacities to make their outputs available as IPGs, possibly made accessible through IRRI. Indeed, the capacity of some centers of breeding and genetics research is much greater than that of IRRI's, and IRRI must seek to develop access to these through strategic partnerships and agreements. The heterogeneity of Asian NARS means that it is impossible to map out a common strategy for these relationships, but there should be a clear IRRI strategy towards each of its national partners.

For China and India, national rice research capacities are so extensive that planning IRRI relationships is probably best done on an individual project level, with periodic joint agreements that simply summarize and validate research collaboration. For some other countries, however, a national prioritization meeting (perhaps every five years) might be useful; not simply to formalize continuing partnerships with IRRI but to provide input to strategic discussions on rice research priorities. Although various IRRI activities may be taking place in a country, these should reflect a common IRRI stance towards development of the particular NARS. At present it is not clear who in IRRI should be responsible for such strategies. IPMO covers this to a certain extent, but as these strategies would embrace technical and institutional issues beyond the expertise of IPMO it may be that a different authority in IRRI, perhaps at a higher level in the Institute, will be required.

The relationships with national programs are made more difficult by the growing complexity of potential NARS (particularly NARES) partners. Not only may there be several types of rice research organization within a country, but the consortium and network approach is leading to new ways of doing business. For instance, as noted, the RWC is now managed by NARS. In addition, attention to delivery and impact increasingly means engagement with a much wider range of partners, including NGOs and the private sector who may or may not have good relations with traditional IRRI partners. Much of this downstream engagement currently takes place at the level of project sites belonging to a consortium. This strategy may serve to identify local collaborators who are most useful for a particular site but not necessarily for scaling up. This emphasizes the importance of some type of national-level diagnosis and strategy that ensures a consistent approach and an effective IRRI 'research for development' strategy in each country.

The technologies that IRRI is instrumental in developing have a much higher chance of being promoted if there is a broad sense of national ownership. The Panel urges IRRI to consider appointing an IRS for 10-15% of his/her time to serve as a known focal point for issues that arise for each significant Asian rice producing country – a sort of “ambassador” for rice related issues, and “guardian” of data, trip reports, GIS analysis and other rice-related information that relate to a specific national system. This country contact would also facilitate the process of developing country plans as the need arose.

Many of these considerations about NARS relationships impinge on decisions about where IRRI posts its staff and what mandates are assigned to out-posted staff. In some countries, the fact that there are fewer IRRI scientists posted in-country is interpreted by NARS as a decline in interest by IRRI, even though the country may host several research sites under consortium approaches. If IRRI’s presence is limited to attendance at meetings and collection of data, effective collaboration between IRRI and national partners may be impaired. The problem is not necessarily resolved by out-posting more people (and unless an IRRI post is well-supported by the national program it may not be productive either for the NARS or the staff member), but more attention is required to analyzing the advantages and disadvantages of having a somewhat higher proportion of staff posted outside of headquarters than is currently the case.

The CCER on Staff Placement recommended expansion of outreach positions and endorsed the concept of country liaison scientists. But there has been little movement towards posting more staff outside Headquarters and a brief experiment with a Mekong Basin regional office lasted little more than a year. IRRI still needs to consider its stance regarding out-posting. Liaison persons have proven to be useful positions, but they do not substitute for the need for IRRI to have a well defined country strategy and sufficient presence (through in-country posts or significant collaborative activities) so that countries feel that they are true partners. As IRRI moves into Africa, it will be interacting with NARS with whom it has much less experience and many fewer links. IRRI will have its principal office in Tanzania but much of its relations with NARS should be mediated by the East and Southern Africa Rice Program (ESARP) which has been implemented jointly with WARDA and participating NARS of four targeted countries. Furthermore, IRRI’s policy on career development and promotion must be seen to be equally applied to outposted scientific staff so that there is no perceived career risk in accepting these posts.

In summary, The Panel recommends that IRRI better define its strategy and objectives for country and regional programs, and that the mandate and functions of the International Programs Management Office (IPMO) be clarified to support these objectives. IRRI should have a well-defined strategy for each of its partner countries. IRRI should designate a staff member to serve as a focal point for each significant rice-producing country in Asia to coordinate information and contacts; for many countries, a meeting (approximately every five years) to discuss national rice research priorities will be useful. The examination of IRRI’s interactions with NARS should also include the possibility of placing a larger proportion of staff outside of Headquarters.

4.3 Relationships with the CGIAR

IRRI’s work on rice places it centrally within CGIAR efforts in germplasm improvement of staple crops for global food and nutrition security. IRRI’s current strategic plan to 2015 sets out a program of increasing global scope which essentially describes the parameters of the CGIAR rice effort (see Section 4.3.1, below). There have also been several rounds of discussion with CIMMYT on the possibility of alignment of the two Centers’ efforts on staple crops and there are increasing cross-Center initiatives either through three Challenge Programs in areas of common interest, or through specialist system-wide programs with sister Centers. There is potential for an increasing role in the Climate Change agenda of

the CGIAR either through the developing CP or simply through its own research on adaptation to stress tolerance.

Rice and the CGIAR: IRRI, WARDA and CIAT

Three Centers of the CGIAR work on rice: IRRI with a global mandate but focusing largely in Asia; WARDA (also known as the Africa Rice Center), originally focused on the countries of West Africa but increasingly with broader SSA perspective, based in part on the success of the Nerica varieties; and CIAT in Latin America. In 2005, the IRRI Board of Trustees and management directed IRRI's attention towards Africa, and an IRRI scientist was posted to WARDA's program at IITA in 2006. Despite earlier difficulties in relations, the two Centers have taken concrete steps to establish a common Africa rice research strategy and program. IRRI and WARDA managements signed a formal MOU in December 2005 in which the basic principles of cooperation were laid out. This has been endorsed by a letter of intent signed by WARDA's Council of Ministers. IRRI posted a senior scientist to Maputo in September 2006. Programmatic alignment will initially focus on improving and exchanging germplasm, and building a cadre of trained scientists, and on a broader scale it also includes CIAT. Further meetings between the Centers included a rice "convening" in July 2007 by the BMGF. The result was a major grant by the Foundation to support an IRRI project (started March 2008) on developing abiotic stress tolerant rice (STRASA), in which WARDA will be a primary subcontractor. The Green Super Rice Project grant, also supported by the Foundation, includes IRRI and WARDA as sub-grantees with China as the lead partner. Additional funding from the Government of Japan for rice breeding at the two Centers is currently under discussion. IRRI and WARDA have been making substantial progress in developing a common rice program for SSA during 2008 through attendance at each others' Board meetings, development of a joint proposal for the Japan TICAD IV undertaking, and the development of the East and Southern Africa Rice Program (ESARP). In addition there have been a number of exchange visits by top management to both Centers during 2007-8.

The situation for rice and the CGIAR in Latin America and the Caribbean (LAC) is less clearly defined. CIAT's rice program has been in steady decline since the mid-1990s after an excellent record in breeding for disease resistance and in training national scientists. Now, virtually the entire senior scientific staff for rice has either left or is near retirement. The future of the forward looking partnership with the private sector (FLAR9) is unclear. IRRI is exploring a direct research relationship with EMBRAPA in the area of aerobic rice. Although this discussion is in its very early stages, the Panel encourages IRRI's interaction with this major research partner in the region.

The Panel congratulates the management of IRRI and WARDA on their leadership and commitment to developing a coherent program for Africa, and feels that IRRI is well positioned to lead the global rice research effort in the next decade, supported by the strong commitments to such a program that have already been made by WARDA and CIAT.

CIMMYT and the IRRI/CIMMYT Alliance

IRRI and CIMMYT have had long standing cooperative activities (e.g. the Rice-Wheat Consortium), and following a joint declaration by both Boards in October 2003 the two Centers explored alternatives for closer collaboration or merger. It has also resulted in the appointment of joint Board members. Discussions were facilitated in 2004 by the Rockefeller Foundation which, after meetings in the presence of the CGIAR Oversight Committee, advised against a complete merger, and subsequently each Center has retained its "brand" identity.

The two Centers have jointly developed and implemented Alliance projects for each of the areas identified in the Rockefeller Foundation report. Each project is intended to have a unified budget and a project leader. Initiatives include the Crop Research and Information Laboratory (CRIL). Although operational issues relate to the large time difference between the headquarters of the two Centers (Philippines/Mexico), and the clarification of the management structure, there is further potential to enhance synergies in computational biology, bioinformatics; and comparative genomics. It appears likely that CRIL will evolve into a systemwide bioinformatics platform, a direction which the Panel urges IRRI to explore. The Cereal Knowledge Bank (CKB) concept has also resulted from the IRRI –CIMMYT Alliance, and is the world's leading repository of extension and training materials related to cereal production. A third initiative is the Intensive Production Systems for Asia (IPSA) whose activities have been described in the Rice-Wheat Consortium. IPSA has received significant support through the BMGF- and USAID-supported CSISA Project, and from GTZ project support for India and Bangladesh, amongst others. Together these projects have breathed new life into the IPSA initiative, and provided a natural vehicle for the further development of the CKB. The Panel finds that the Alliance has had a positive impact, and without its original work and significant research impacts (Chapter 3) the foundation upon which CSISA rests would be far less solid. The Panel agrees with the earlier analysis that institutional merger is not necessary for close working relationships.

Links with Challenge Programs

IRRI actively participates in three Challenge Programs: in the Generation CP (in both commissioned and competitively won projects); in Harvest Plus as the rice leader (almost entirely commissioned research); and in Water and Food as the managing Center and leader for Theme 1 (almost entirely competitive grants). Research at IRRI supported by the Challenge Programs is embedded within the seven programs, their outputs and output targets.

Generation CP (GCP)

The Generation Challenge Program, Unlocking Genetic Diversity in Crops for the Resource Poor, brings together a consortium of researchers from IARCs, NARES and ARIs, and seeks to use genetic diversity and genomics research to solve difficult production problems, with a particular focus on drought. Thus GCP strategy aligns strongly with IRRI's, and until recently an IRRI IRS was the sub-Program 2 leader. IRRI has greatly benefited from the resources and collaboration opportunities brought about by involvement in GCP. Through several GCP projects and through targeted investments from IRRI's reserves, IRRI has completed analysis of the population structure of a substantial collection of rice germplasm, developed the OryzaSNP project, and made considerable progress towards establishing a functional SNP platform. The genomic resources and projects developed with GCP funding and cooperation were strongly endorsed by the recently concluded CCER on IRRI's Biotechnology program. The drought and salinity breeding networks initiated by IRRI have received strong support from the GCP, and the GCP helps improve infrastructure and use of marker applications at several NARES institutions (e.g., in Bangladesh, Indonesia, and India), and has sponsored degree and non-degree training of NARS scientists. An especially significant contribution of GCP to IRRI has been in expanding IRRI's bioinformatics team and providing hardware for this, particularly in the development of Web interfaces to crop and genomics information within IRRI's database, IRIS. The GCP also contributes significantly to the staffing of the CRIL, and improves technical capability in the analysis of function and comparative genomics data.

IRRI also views the GCP as an important mechanism for attracting intellectual contributions from scientists at ARIs. Although GCP is narrowing its list of target crops, rice remains one of its priorities. IRRI therefore expects to continue playing an important role in GCP priority activities, and in its future research strategy. Since the initiation of the GCP, IRRI has received grant support of approximately US\$7

M (as of June 2008), averaging US\$1.4 M per year, and is the largest recipient of GCP funds. Despite the close research links, the Panel senses that GCP appears to be viewed more as a donor than as a research partner supporting IRRI's strategic research initiatives. The Panel urges IRRI to have high level strategic discussions with GCP, and to share equitably in attribution, and where possible, in research planning as well. This will become even more important as research on water-related traits matures, and a new round of gene discovery ensues.

Harvest Plus Challenge Program (Harvest Plus CP)

IRRI collaborates in the HarvestPlus Challenge Program on the development of nutritionally enhanced rice germplasm and this is integral to the focus of IRRI Program 4. The work at IRRI brings together the ongoing and planned efforts on the development and deployment of rice germplasm with increased content and/or bio-availability of pro-vitamin A, iron, zinc, and Vitamin E, and with improved protein quality (higher lysine content). These Outputs link IRRI's commitments under Harvest Plus to the Golden Rice Network, and to the BMGF-funded Grand challenge #9 Project. IRRI is appreciative of the technical support it receives from the HarvestPlus CP in areas such as nutrition and consumer acceptance. It is expected that the work will extend to the evaluation of the needs and development of solutions to additional micronutrient deficiencies (e.g. vitamin B1). Grant funding received by IRRI from the Harvest Plus CP since its inception totals US\$2.78 M.

The Water and Food Challenge Program (CPWF)

IRRI is a founder member of CPWF, and has maintained its Steering Committee membership since 2003. IRRI has led and helped shape the research agenda of Theme 1 (Improving crop water productivity; one of the 5 themes of the CPWF). Total funds for IRRI-led research and program leadership are US\$5.4 M to date. IRRI's commitment to the goals of Theme 1 has gone well beyond its interest in rice, and their leadership into the effects of saltwater intrusions in coastal systems is considered exemplary. Participation in the CPWF allows IRRI to implement its core research agenda in coping with water scarcity with new partnerships that, in many cases, helped IRRI extend its research beyond the plant and field level. IRRI is seen by CPWF as a highly reliable research partner, and the Panel congratulates IRRI on this partnership. It notes that CPWF in its second phase will be focusing on the Limpopo Basin in south east Africa – a region with considerable potential for irrigated rice.

Systemwide programs: SGRP

IRRI's Genebank is an important contributor to the System-wide Genetic Resources Program of the CGIAR. Studies of genetic diversity in IRRI's and others' accessions should lead to a rationalized system for the conservation of rice genetic resources in collections worldwide, and is in collaboration with the Global Crop Diversity Trust. Through SGRP there are also particular linkages to WARDA and to CIAT to establish new approaches to jointly improve the efficiency of maintaining and delivering appropriate germplasm in Africa, Latin America and Asia.

Panel assessment

The Panel congratulates IRRI on its initiatives in partnership with other CGIAR Centers, and notes that IRRI is held in very high esteem by them. Especially noteworthy is the long-standing collaboration with CIMMYT now formulated as the IRRI-CIMMYT Alliance. The close working partnership that has been developed recently between IRRI and WARDA has already yielded additional generous support from investors, and the Panel urges IRRI to take all reasonable steps to institutionalize this partnership to ensure durability. We conclude that, on the basis of firm and cordial relationships with WARDA and CIAT, IRRI is well positioned to lead the CGIAR rice research agenda into the next decade. Within this relationship IRRI's comparative advantages in Asia will be the provision of adapted germplasm and

complementary growing practices. For Africa, it will be primarily for lowland rainfed and irrigated germplasm, while uplands should remain the domain of WARDA. Which Center, if any, has a clear mandate to lead upland rice research? There are limited opportunities for spillover from upland research conducted in one region to another because upland environments are typically heterogeneous in farming practices, cropping systems, climate and soils. For this reason the Panel concludes that there are few savings to be made by allocating responsibility for strategic upland rice research to any single Center. Germplasm should be regularly exchanged among all three Centers.

Challenge Programs have played an important part in supporting IRRI's agenda. IRRI has used these partnerships to good effect, and with the GCP and CPWF it leverages its research on water related traits, bioinformatics and growing practices. Both Challenge Programs have found the level of IRRI's execution of goals and strategies at the project level to be very satisfactory. There has been some reduction in IRRI's direct research investment in the area of genomics and water management practices resulting from the increased support received from GCP and CPWF. Challenge Programs, however, need be viewed by IRRI as partners in developing and executing the Institute's research agenda, rather than simply sources of additional funds for projects within IRRI's core research strategy. The Panel urges IRRI to engage with the Challenge Programs through an annual consultation between its DDG-R and the Directors of each.

4.4 Relationships with Advanced Research Institutions (ARIs)

IRRI has historically, and currently maintains, a very large number of formal and informal cooperative research relationships with many scientists in ARIs spread out all over the world, in universities, Government-funded research institutions, NGOs, and research charities. Over the last decade, the emergence of rice as a major genetic and genomics model for cereal biology in general has attracted front-line scientists from many non-rice growing countries in the northern Hemisphere to invest in rice biology as a means of understanding plant processes. Much of this was started by participation of ARIs in the Rockefeller Foundation-funded Asian Rice Biotechnology Network for example, the enduring relationship with Cornell University. IRRI's germplasm, technology and infrastructure continue to attract top expertise into collaborations, as recently demonstrated by the partners involved in the C4 rice project, and this provides leverage to gain access to knowledge, resources and expertise that IRRI does not have. As in most scientific endeavours, collaboration is driven by mutual curiosity in aspects of plant biology, and joint proposals for cooperative work can arise from meetings at conferences and workshops, or from mutual interest in publications. The Panel strongly supports these links as a means of strengthening IRRI's mission to apply science to developing world agriculture. It encourages IRRI to continue to augment established links and to make new ones through both formal joint-funded projects or, more informally, through inviting peers from advanced research institutes to IRRI as visiting scientists for short or long visits.

It is commendable that IRRI now has formalized research relationship with the major scientific institutions of the major rice growing countries, India and China. The recent (December 2008) meeting between 15 IRRI scientists and Chinese scientists in Hangzhou, China, funded by the National Natural Sciences Foundation of China, could lay the foundation for expanded cooperation with the top rice research labs in China, funded by the Chinese Government. IRRI should grasp the opportunity afforded by this link, and encourage a sharing of China's very considerable genomics and germplasm resources as IPGs for the benefit of resource-poor rice producers and consumers.

4.5 Relationships with the Private Sector

IRRI's activities with the private sector cover a range of interactions, from receiving funding for 'no strings attached' research activities, to joint projects for the development of products or understanding of mutual benefit, to negotiations for the acquisition and transfer of IP for IRRI-led program research activities. IRRI's current philosophy for collaboration is that the relationship must have clear relevance for IRRI's mission as indicated in its Strategic Plan, the interaction must enhance research capacity at IRRI, must not interfere with its collaborations with, and support of, NARS, must be on a non-exclusive basis and have full-cost recovery. IRRI rightly does not carry out contract research, such as 'product testing', or the promotion of products, nor activities that could contravene biosafety rules or host country laws.

The current interest in rice varieties and rice research, particularly genomic research, by national, regional and multinational seed and biotechnology companies, has created a complicated scenario. The delivery of IRRI hybrids by private seed companies has meant that IRRI germplasm is being registered and marketed by private companies; biotechnology companies have cloned genes or possess genomics information that could, potentially, greatly enhance IRRI's research and impact, for example on drought tolerance. The 6th EPMR encouraged IRRI to interact more with private industry to obtain access to advances in genetics and genomics. This new situation requires IRRI to reassess its 'rules of engagement' and how its freedom to operate, in terms of freedom to publish and freedom to release materials and results to traditional partners, can be balanced with the requirements for exclusivity and closer partnerships with individual companies. Several large multinational companies have recently approached IRRI for joint projects and IRRI needs a set of rules to provide common principles for contracts with different companies. It needs to consider how it can cooperate without contravening its basic philosophy; and determine what it wants back in terms of resources that are transparent and accountable to its stakeholders - i.e., to develop a risk-benefit approach.

A recent precedent has been set for private-public partnerships by the formation of the Hybrid Rice Research and Development Consortium (HRDC). This consortium was formed in 2008, and comprises a mix of private and public sector institutions which contribute to the cost of rice hybrid development conducted on their behalf by IRRI. Membership costs, paid as grants to IRRI, are determined by category of membership for private seed companies, but fees are not mandatory for public institution members (although voluntary contributions are possible). Right of access to germplasm developed by the HRDC reflects category of membership, though inbred lines developed by IRRI with HRDC funds will be supplied free in small amounts to public sector organizations on request, subject to conditions imposed by IRRI in the SMTA. The HRDC agreement is a carefully thought-out series of obligations and benefits to both sides, and could be a template for further such consortia. The Panel considers this an innovative private-public sector model for collaborative development of superior lines and hybrids that will serve well IRRI's goals to deliver superior rice germplasm to farmers. Because free access to public sector organizations to all classes of inbred lines has been maintained, the Panel sees no significant conflict between the provisions of the HRDC and the IPG requirements of the CGIAR product dissemination policy. If successful, the HRDC will continue to fund research aimed at increasing the genetic diversity of public and private hybrids, increasing heterosis and reducing the cost of hybrid seed. Ensuring that research results meet member expectations may require additional funding of HRDC by IRRI in its initial stages.

4.6 Final comments

Relationships with clients, fellow researchers, and sister institutions are the key pillars upon which IRRI's institutional success rests. They will undoubtedly become more important with time, as the number of

players grows, and as communication among colleagues at all levels becomes easier. Establishing good partnerships requires a high level of trust, shared goals, good and frequent communication, mutual accountability and equitable attribution. IRRI continues to be highly respected as a collaborating institution that relates well to its partners. The Panel notes that partnerships should not be taken for granted as they are rarely static and need to be monitored in relation to regional and national developments. There will be an increasing diversity of partnerships for IRRI in the future, and each will require attention to be able to flourish. Keeping this in mind, the Panel expects IRRI to move forward in planning and executing its research agenda confident of the support and cooperation of its key partners.

On Partnership support: Training and Capacity Building. The report also recognized IRRI has an enviable record in training; virtually all NARES leaders speak with great respect about IRRI's training investment (and worry about the declining funds available for this activity). IRRI has managed to maintain much of its capacity to provide high quality training while moving to embrace new methods and modalities. Most CGIAR Centers have had to abandon the majority of their long-term, in-service training courses (and IRRI's largely empty dormitories are evidence of this shift) but the range and quality of IRRI's training staff and facilities have meant that the institute has the critical mass and flexibility to move effectively into the provision of short-term courses. The training staff includes people experienced in course facilitation and design, providing opportunities for collaboration with partner institutions in course development. Between 2004 and 2008 IRRI offered 91 short courses (at headquarters and in-country). These courses include the technical topics that one would expect and some important additional topics (such as scientific writing or leadership for Asian women) that help further IRRI's mission. Since 2007, all of this training has been done on a cost-recovery basis. One drawback is that poorer countries, especially those not part of major IRRI projects, may be unable to send participants, and explorations are underway to identify funding sources to address this problem.

IRRI has also been a leader in providing and supervising post-graduate training, and the proximity of UPLB has facilitated this role. Between 2003 and 2008 IRRI facilitated 69 MSc and 110 PhD degrees. Previously, the lion's share of these degrees was awarded by UPLB but by last year scholars were registered with 23 different universities. Most are "sandwich" programs from universities in other countries. The provision of post-graduate supervision remains an important priority for IRRI, but the time demands on senior staff are considerable, especially for divisions like SSD with few senior staff.

There is concern about the aging population of rice scientists in national programs. Support for post-graduate training may help address this, although the problem has its roots in larger changes in national economies. It may be worthwhile for IRRI to attempt to document the extent to which the problem exists, note any differences across countries and disciplines, and draw lessons for training priorities. Further, it would appear that a considerable proportion of IRRI's training resources will soon be focused on Africa. There is certainly a need for training, although it will be important to do a careful assessment of actual needs and absorptive capacities, as some donors may find it easier to put money in training courses instead of facing more difficult policy and institutional development issues in Africa. The establishment of a well-organized rice production course at an African venue will be a high priority, especially since the number of trained rice scientists in SSA is very small.

F. Biodiversity 6th EPMR, July 2009

The EPMR report discusses partnerships at length in Chapter 3 "Modus Operandi" through the center's strategy and also in detail by Focus Areas (FA) of research programs implementation. There are a

number of findings and “suggestions” but paradoxically only one formal recommendation touching upon partnerships marginally.

Recommendation 9. “The Panel recommends that Bioversity better define, express and evaluate its outputs, outcomes and impacts and communicate effectively internally and externally the value of Bioversity and its partners’ work.”

Center’s response: **Accepted.** The EPMR report recognizes the difficulty of measuring outcomes and impacts of Bioversity’s work. However since 2008, Bioversity has developed tools for monitoring outcomes and impacts, for capturing and documenting them, for ensuring that they are promoted and that the lessons from them are fed into current activities. The first fruits of these efforts were seen in the 2008 CGIAR Performance Measurement System report, in which Bioversity significantly improved its performance over previous years. The recently recruited Director for Communications is developing a new Communications Strategy which will ensure that our outcomes and impacts are well documented and leveraged widely with our partners, clients and supporters. Bioversity will also make greater use of its intellectual capital in order to demonstrate the contribution of agricultural biodiversity to important global debates, such as those on food security, climate change and economic development.

Excerpts of the overall discussion on partnerships are as follows:

“Since its creation, Bioversity has sought to implement innovative ways to incorporate partnerships at the global, regional, national, and local levels. To do so, Bioversity has implemented several specific strategies: i) develop collaborative partnerships at different levels; ii) support regional networks, and iii) support commodity networks. Bioversity now assumes several roles, including: research, advocacy, policy and legal work and capacity building. In the past five years, Bioversity has been moving to a more global strategy, and correspondingly reducing its efforts at strengthening national programs and regional networks. According to Bioversity, this explicit decision was based on the following premises: a) national programs linked to plant genetic resources have improved in many countries; b) the regional networks are up and running on their own and c) the emergence of global policy agreements and instruments have created the basis for more support for the regional and global efforts in Plant Genetic Resources (PGR) conservation and use. In particular, the ITPGRFA is considered by Bioversity a useful global framework and the challenge assumed by Bioversity is to promote its implementation at the regional and national levels.

Partnerships have been and still are fundamental to the functioning and implementation of Bioversity’s research agenda. Earlier partnerships focused on strengthening national programs for PGR. Currently, Bioversity engages with a very wide range of partners in planning and implementing agricultural biodiversity research. As such, it seeks to leverage expertise, capacities and resources from other organizations in support of its mission. The partners’ capacities vary throughout the Regions in terms of knowledge, skills, laboratory infrastructure, equipment, and, importantly, in relation to their linkages with national, sub regional and regional decision makers.

3.1 Varying roles of Bioversity

Bioversity is seen as a research organization with very valuable scientific and technical knowledge and contacts. Bioversity conceptualizes plans and implements research in collaboration with partners. From the review of the documentation and the interviews carried out in the Regions with the staff, Bioversity is considered a key organization in:

- Capacity building, organization and implementation of training

- Research management
- The promotion of scientific networks
- Project design and fund raising (broker role)
- Network development, particularly in AB use and conservation
- Production of scientific and technical publications

Bioversity has a positive image, in particular because it is not considered as an implementing Organization competing for funds with partners; instead it is seen as a Center that provides necessary financial and technical/scientific inputs so that its partners can meet their mandates. An aspect that was highlighted by the majority of such partners is the impetus that Bioversity gives to necessary and complementary actions in conservation in situ and ex situ. This is a change that the partners have noted (in particular the attention given to in situ conservation) that is considered as fundamental to advance the conservation and use of local genetic resources.

Another positive element of Bioversity is that because of its international positioning it gives national and sub regional partners more “visibility” at the regional and international levels.

3.2 Collaborative partnerships for projects’ and initiatives’ implementation

Besides its Rome HQ, Bioversity has 5 regional offices (temporarily reduced to 4 since early 2009) and 10 country offices. Half of the staff is based outside HQ. In virtually every office outside Rome, Bioversity is hosted by a partner organization: international bodies, NARS and CGIAR centers. This helps the Center to avoid owning or renting physical facilities and allows Bioversity to play out its critical roles with partners more effectively. Bioversity works globally with a range of partners (about 260) such as individuals, organizations, regional bodies (e.g., networks) and global organizations and programs. They vary greatly in their capacities and degree of linkage with national, sub-regional and regional decision makers. Research organizations (mainly governmental organizations) are the most numerous and important of Bioversity’s partners (see Fig. 3.1).

Type of Partners	% of partners by type
Business/private sector	3%
Educational organizations	14%
International agricultural research Centers	1%
Governmental organizations	13%
NGO	7%
Others	2%
Regional organizations	7%
Research organizations	40%
UN organizations	2%
CG Centers	10%

Figure 3.1 Elaboration of Bioversity’s partners by type.

Source: elaboration based on http://www.biodiversityinternational.org/Projects/Search_our_current_work/aspx/Partner_Search.aspx?item=2

The criteria used by the Center in selecting its partners include: technical or scientific competence, opportunity for multiplying effects (scaling up), geographic relevance, cost effectiveness (i.e., leveraging potential of the partnership) and opportunities to achieve other institutional objectives such as capacity building, influencing policy and public awareness. In theory, Bioversity's direct involvement in these initiatives ends at the pilot testing stage when a technology has proven itself suitable for scaling up and scaling out. However, no systematized documentation was found from the documentation provided nor from the field visits that reported the formal phasing out of Bioversity after pilot testing and scaling up being in place.

Bioversity claims that many benefits are derived from operating in a partnership mode, including reduced needs for infrastructure and minimum overheads, increased intellectual exchanges and research collaboration, more sustainable outcomes and impacts and capacity building. According to the Center, the close engagement at the local level allows Bioversity researchers to provide authoritative input and feedback to the Center's own priority setting process. Bioversity estimates that in 2007, its partners contributed over US \$2.4 M as well as in-kind contribution estimated at over US \$7 M towards collaborative research activities. However, systematic estimation in the project and activities budgets in each programmatic area is not available, despite the fact that this type of information is critical to illustrate Bioversity modus operandi benefits.

The Panel suggests that it would be useful to document work on projects and activities, showing the financial and in-kind contribution of partners. This information should be available at regional and country level to evidence Bioversity leveraging of funds and efforts.

The Center believes that this type of collaboration often serves to extend the geographic coverage of Bioversity's work, so that lessons can be drawn from a range of agro-ecologies, production systems and crops. However, some partners in particular governmental institutions interviewed in the regions feel that Bioversity has withdrawn from national and network activities that were very valuable to them. Regional and subregional integration bodies, in particular in the developing countries, have an increased role and there is a need for those regional bodies to strengthen their policies in agriculture and environment. For example, in Central America and the Andean Region a regional strategy for Agriculture, Environment and Health was approved recently, and regional initiatives on climate change are being elaborated through the Commission Andina). All these organizations, e.g., Consejo Agrícola Centroamericano, Comisión Centroamericana para el Ambiente y el desarrollo, Comisión Andina and associated bodies are developing regional and sub regional policies related to key issues such as climate change adaptation and mitigation and sustainable agriculture with the support of several donors. Bioversity should consider in a more systematic way those organizations as possible "avenues" to influence policies related to environment, agriculture and health.

Panel Assessment. The information as presented by Bioversity does not allow others the opportunity to clearly grasp the projects developed in the subregions and countries. Bioversity's web pages also do not provide in a user-friendly manner this type of information which is so relevant for an international organization such as Bioversity. The Panel suggests that Bioversity improve, according to the different targets and interests, its information, communication and dissemination systems of its worldwide activities, by regions and priority and how these leverage local resources. Although Bioversity has developed long term relationships with key partners, it is increasingly involved in generating new

partners dealing with new issues in order to complement its capacities in specialized fields such as health and nutrition, e.g., the Center for Public Health and the Medical Research Institute in Kenya. Thus, as Bioversity is growing and engaging with a larger number of partners, due to the complexity of the complementary themes, it must manage its projects/initiatives with greater skill and efficiency. In particular, certain projects, such as those in Diversity for Livelihoods (DFL), Understanding and Managing Biodiversity (UMB), and Commodities for Livelihoods (CFL), need to dedicate more time in the respective countries/regions to the coordination, establishment, and strengthening of working teams and following up with partners' organizations.

One of Bioversity's strengths is involving partners from the planning stages of project research all the way through to the implementation of results. This has resulted in greater acceptance and involvement of its partners in projects. The technical and scientific credibility of Bioversity has enabled it to introduce innovative themes into national programs. Perhaps most importantly, collaboration between Bioversity and their partners have resulted in effective transfers of technology to targeted groups, e.g., in the project in the Philippines on enhancing the livelihoods of small-holder farmers in the Cagayan Valley. This is a good example of Bioversity moving results from basic pathology research all the way to the farmers' fields via the national extension system.

The work that Bioversity carries out in several countries, regions and sub regions should lead to a more systematic analysis and exchange of information among projects dealing with the same problems. This is one important comparative advantage that Bioversity should fully capitalize.

The Panel recommends that the Center promote greater cohesiveness, synergies and learning within and between Focus Areas, projects and geographical regions, so as to use its resources more efficiently and enhance the value of its investment.

3.3 Regional networks on plant genetic resources¹

Networking has been and continues to be a key element in the modus operandi of Bioversity. Networking is done both through formal and informal networks. Bioversity's engagement with networks—both regional PGR and commodity networks — has evolved with time. During the IBPGR and IPGRI eras, regional networks were seen as mechanisms to support national program development in PGR. Hence, Bioversity was involved in creating, managing, facilitating and supporting the way networks operated. Currently, there are several regional PGR networks functioning in support of national, regional and global agendas in PGR management, for example, SANPGR (South Asia network on PGR), WANANET (West Asia and North Africa PGR network), EAPGREN (East African PGR network). There is no doubt about the global public goods nature of these networks and the services they provide. The role of Bioversity focuses on providing information and knowledge products including methodologies delivered by core programmatic work. One of the best examples of its strong regional network support would be the role of Bioversity in the coordination and development of the European Genebank Integrated System (AEGIS). This exemplified the balanced sharing of PGR conservation responsibilities within the regional network system. Some of the important outcomes of the regional networks include: 1) the effort toward a more standardized system of data acquisition and management at the accession level, as

¹ European Cooperative Programs on PGR (ECPGR); European Forest Genetic Resources network (EUFORGEN); South Asia network on PGR (SANPGR); Pacific Agriculture PGR network (PAPGREN); Regional network for conservation and use of PGR for East Asia (EA-PGR); Regional cooperation in southeast Asia for PGR (RECSEA-PGR); Genetic Resources Network for West and Central Africa (GRENEWCA), East African PGR network (EAPGREN); Southern Africa development community PGR (SPGRC); West Asia and North Africa PGR network (WANANET); Mesoamerican network on PGR for Central America and Mexico (REMERFI); the Andean network on PGR (REDARFIT); the Amazonian network on PGR (TROPIGEN).

seen in the Sub-Saharan Africa Region national gene banks; 2) collaboration in genetic resource conservation, as seen in the long-term storage facility in Zambia for the Southern African Region and, 3) the resulting increase in funding opportunities, such as through the European Commission funding.

In the presentation on *modus operandi* to the Panel, Bioversity indicated it would continue to be committed to networking as the best approach to organizing, facilitating and promoting international collaboration among network partners. However, it will not continue to support the establishment of new or development of established networks as it has done in the past. Rather, it will utilize the potential opportunities that the existing Regional Networks now offer. In particular, Bioversity will look to promote new research issues that go beyond PGR conservation and support research projects in nutrition, livelihoods and climate change.

According to Bioversity, three key developments have influenced its new approach and “changed paradigm” towards networks: i) the maturation of a number of the networks; ii) the emergence of strong NARS and subregional organizations; and, iii) the emergence of a number of supporting global policy agreements and instruments. Bioversity now places a stronger emphasis on “strategic technical research collaboration involving priority setting, strategic research and capacity building”.

Panel Assessment. Even if some regional networks and national programs on genetic resources and agricultural biodiversity have improved in a few developing countries, the need to strengthen the capacities of national institutions and regional networks through close follow up, joint research projects and advocacy still remains strong. Relevant information generated by the research at the national level must be shared and adapted through partnerships and networks to other countries/areas and at a regional level. In addition, and as mentioned previously, subregional organizations are increasingly defining the programs and policies and these need to be supported based on scientific and technical knowledge generated in the countries by the NARS. In this sense, Bioversity should not overestimate the capacity of regional networks and national programs in the implementation of research projects.

3.4 Commodity networks

Commodity networks are still the main channels through which research on musa, coconut and cacao are undertaken by Bioversity and its partners. Bioversity supports different types of commodity networks (see Table 3.1):

- Genetic resources networks: MusaNet, CacaoNet and COGENT-coconut network.
- Regional networks on banana: MUSALAC -15 countries from Latin America-, BARNESA (10 countries from East and Southern Africa), MUSACO (13 countries from West and Central Africa) and BAPNET (Asia and the Pacific and Oceania). REDIMA is another specific information network which includes countries members of MUSACO and BARNESA.
- Research networks: ProMusa involved in banana breeding, pests and production, the Global Genomics Consortium and the PROCORD involved in coconut breeding, pests and production.

The agenda for each of those networks is guided by a global conservation strategy developed in partnership with the Trust. In the case of CacaoNet the global conservation strategy is in progress. For example, the long term support of the International Coconut Genetic Resources Network (COGENT) has provided for activities not only in genetic resource conservation, but additionally there has been the development of value-added products beyond copra, such as coconut husk dust fertilizers, specialty coconut foods, and saleable arts and crafts from the nuts and wood. These activities have provided for a more sustainable livelihood for those living in areas where coconut is a staple food. In 2006 Bioversity recognized the need to safeguard the genetic diversity of cacao in order to have secure breeding

germplasm available. The development of CacaoNet was supported by Bioversity to the extent that Bioversity was requested by the Network to provide the Coordinator. This effort is significant in that through the activities of the network, much cacao germplasm was put into the public domain and therefore made available to a broad base of cacao breeders.

The Panel found that the role of Bioversity in developing, coordinating and promoting participation in various networks around the world is highly valued by the stakeholders and partners. The progress in capacity building in national programs was specifically highlighted during the field trips by panel members. These networks have provided for the advancement of important crops (banana, coconut, cacao) in poor areas, as well as the utilization of highly specialized data bases by researchers from all around the world. The impact of providing support to these networks is recognized by the panel as a major accomplishment during the period under review.

Panel Assessment. It is clear that the integration of IPGRI and INIBAP into Bioversity was a highly significant event, and brought an important role for Bioversity in the long term conservation of genetic resources of dessert and cooking bananas, as well as the associated basic genetic research. The addition of CacaoNet and associated involvement into Bioversity should be continually assessed and evaluated, as well as activities in the COGENT commodity network. Bioversity needs to carefully assess its potential role in the new CGIAR, and determine if maintaining responsibility for crop (banana, cacao and coconut) PGR via a network approach is fully effective, especially in light of the importance of these crops to the poorest of farmers in the world.

3.5 Overall Assessment of modus operandi

Bioversity's modus operandi has many strengths. It enables Bioversity to select the best scientists and other experts with the right local knowledge to tackle particular challenges. In effect Bioversity broadens its expertise. In theory the approach should enable Bioversity's partners to provide authoritative input and feedback to the Center's own priority setting process. However, the extent to which Bioversity uses this was not clear to the Panel. The use of partners on such an extensive scale also has weaknesses. Bioversity does not control the work of its partners and so has a more difficult job of sustaining the exact protocols of the research and the quality with which it is done. Thus the choice of partners is crucial. The frequency of effective communications between Bioversity and partners is also critical.

The Panel found that the role of Bioversity in promoting the establishment of and developing and participating in various networks around the world is highly valued by the stakeholders and partners. The networking model for carrying out research adopted by Bioversity appears to be suitable for many sorts of research providing the right partners are selected and all the participants' buy-into the work and can share in the ownership of it. Bioversity should not overestimate the capacity of regional networks and national programs in the implementation of research projects. Capacity building ought to be high with this modus operandi.

Collaboration between Bioversity and its partners has resulted in an effective transfer of technology to targeted groups. The Panel suggests that Bioversity improves, according to the different targets and interests, its information, communication and dissemination systems of its worldwide activities, by regions and priority. This will enhance the value of Bioversity's investment. Sharing of the experiences from one project to another within Bioversity efficiently should also help Bioversity to run a global strategy more effectively.

Overall this modus operandi has much to commend it if the projects are properly inspired, designed and managed and the potential weaknesses are fully recognized.

Partnerships in implementing Research Programs are analyzed in detail in the document for each Focus Areas (FA) providing a more precise description of Bioversity's working relations with partners. The Panel expressed for Each FA an opinion on "Relevance and quality of partners chosen, choice and design of projects, objectives, activities". And although overall comments are positive, a number of differences emerge from these descriptions depending on the type of research they concern and/or the capacity of the partner with whom they are implemented.

Regarding FA 1 "Managing agricultural biodiversity for nutrition, improved livelihoods and more sustainable production systems for the poor", the Panel notes:

"Some of the partners of Focus Area 1, especially in the Neglected and Underutilized Species (NUS) project, have established a good relationship of mutual respect with Bioversity, maintaining due recognition to the participation of partners and facilitating the implementation and coordination of the activities. Partners are key national (governmental and nongovernmental) actors in agro-biodiversity issues, and several of them are also well-positioned to influence national public policies. A positive characteristic of Bioversity's modus operandi is the joint publication of results with partners. The recognition and respect of intellectual property of partners and their participation in the publications is very positive."

Regarding FA 2 "Conserving and promoting the Use of Diversity in selected Commodity Crops of Special Importance to the Poor":

"The assemblage of partners in work being conducted specifically on banana and cacao is highly relevant, but the Panel feels that the specific activities need to be reassessed by Bioversity in terms of better securing the future conservation of these crops. Whereas the world collections held in trust by all but one of the CGIAR Centers are housed at locations where the physical infrastructure has as much long term security as possible, the cacao and coconut collections are held in nationally owned or academic institutional facilities. The Musa collection is held in trust by Bioversity. The Panel fully expects the partner countries holding these collections to continue long-term support, but concludes that if there were a CGIAR site dedicated to the conservation of these crops, then long term security would be better assured. The Panel fully realizes that the cost of maintaining this type of germplasm is significantly more expensive than orthodox seed producing crops, and that this fact alone may be the limiting factor.

Activities in developing strategies and tools for network-based priority setting, partnership formation to develop Global Public Goods (GPGs) is highly relevant, and will progressively sustain the conservation of the crops and utilization for the betterment of the poor farmer until such time that a physical international center may be developed or found for the conservation of each of these crops. The Panel foresees that the Bioversity role in supporting and sustaining the evolution of these crop networks is vital."

Regarding FA 3 "Enhancing the Ex situ conservation and use of biodiversity":

"The partners at the national level are of critical importance in the implementation of technologies provided by Bioversity, as well as the deployment of materials related to capacity building/strengthening. There is considerable evidence that Bioversity has sustained the ability to forge

and lead partnerships in this Focus Area, to carry out research relevant to the needs of its clients, and to convene experts to contribute to collaborative integration of knowledge. Many of these partners are at the cutting edge of research in fields related to conservation and use. The whole collaborative group is serving the world of gene banks and the associated information science in a laudable way. Their principle that those interested in ex situ germplasm information need it in the format they can most easily use it is to be applauded. It is clear from our field trips, that there is nominal support at the local and national levels within the regions. Similarly, there are examples of good liaisons with research partners at advanced institutions, but there are indications that Bioversity has not capitalized on all of the entities that are more than willing to collaborate on research projects.

The Panel has some concern that stakeholders who are habituated to strong Bioversity support in the past, especially in terms of training, funding and capacity building, continue to expect the programs to continue. The Panel suggests that if Bioversity does, in fact, plan to scale down activities and foci from the past, this should be communicated down to the field levels in an appropriate way to manage expectations and thus maintain the good name of Bioversity.”

Regarding FA 5 “International Collaboration on Conservation and Use of Agricultural Bioversity”:

“The Panel noted that the activities of the SGRP are highly valued and commended by CG Centers and partners of Bioversity. The Panel commends the work of the SGRP in supporting the negotiations of the Treaty and underlines the important role it should continue to play in supporting implementation of the IT. The Panel believes that Bioversity has strategically selected the most appropriate partners to develop the GIGA concept and position itself as the main player in deployment and implementation of critical information networks such as SINGER, EUNESCO and GRIN–Global. The value of the overall program of GPP is in the judicious selection of quality partnerships. The challenge will be to obtain longer term commitments for collaboration or funding.”

II. Challenge Programs

A. Challenge Program on Water and Food (CPWF), CPER Report, January 2008

[1 Extract from the Summary record of Proceedings of Annual General Meeting, 6-7 December 2007]

“Discussion:

CPWF:

- The value added by the CPWF, in the view of some Members, is the important network capital that is created.
- The review panel’s recommendation regarding the revision of the governance structure aimed at increasing independence of the CPWF from CGIAR Centers was welcomed. A view was expressed that ownership of CPWF stakeholders must be strengthened, and that staff of the CPWF should not be exclusively managed by IMWI.
- EIARD expressed concerns about financial management issues raised by the review; agreement with IWMI for service support needs to be adjusted.

Conclusion and Decisions:

- The CGIAR endorsed the ExCo recommendations on the 1st CPWF and HarvestPlus CP External Reviews.

- The CGIAR must consider a minimum set of standards and principles on governance for Challenge Programs. Experience to date, lessons learned, and the first set of external reviews can serve as input. The CGIAR Secretariat was requested to present to ExCo 14 some thoughts on a minimum set of guidelines/principles for governance of the CPs, also incorporating inputs from the workshop on institutional issues of research partnerships, scheduled to be held in France in February 2008.

Excerpts of Science Council Commentary on the First External Review of the Challenge Program on Water and Food (CPWF), September 2007

The report provides a mixture of recommendations, some strategic and some less so, perhaps reflecting the difficulties of reviewing such a complex program with insufficient time at the end for the team to “gel” and distil a fully integrated report. Still, the report has addressed the generic and specific terms of reference and has provided an analysis of key issues and offered a number of recommendations (22 program-related and 11 governance and management-related), that will be important to the success of the CP and which must be addressed urgently in the beginning of the 2nd phase. The CPWF CSC and Management Team basically agree with all of the program-related recommendations but are not in agreement with several key governance related recommendations. Overall, the Panel supports the continuation of the CP into a 2nd phase, as does the SC.

Program-related

The Panel acknowledged the success of the CPWF in initiating a complex, multi-institutional, and ambitious research program which has strengthened linkages between CGIAR Centers, NARES, ARIs and NGOs. In the Panel’s view, results thus far justify the establishment of the CP and, assuming the recommendations are implemented, the CPWF should be able to generate good scientific outputs in the future. Understandably, the review was unable to adequately address issues of impact after only three years of project implementation. However, the review has been able to look at the functioning and quality of the elements of the CP that are now in place and from that analysis predict a strong likelihood of measurable outcomes and achievements in the 2nd phase. While the SC shares some of the optimism of the Panel in this respect, more specific examples of significant outputs, outcomes and exciting early results thus far achieved by the program – even identification of critical research hypotheses being examined – should have been cited, which would have strengthened this assessment. This, in turn, would have provided more convincing assurances of the programs expected impacts in the future.

The Panel has provided an assessment of the program’s strategy (p. 26-27), which is highly critical of the objectives and focus – too broad, unclear and providing little guidance. Indeed, the core recommendations of the Panel focus on the need to sharpen and re-define the vision, mission and objectives of the CP. Related to this is the need for the program to specify well-defined areas of research activity to avoid problems associated with an overly broad specification of its objectives. CPWF Management agrees with these key recommendations and acknowledges the need to specify a set of achievable objectives more clearly for the next phase. The broad scope and lack of focus in this CP is a recurring theme in the SC commentaries of previous MTPs, and is now supported by this External Review. It is paramount that the issue of focus is addressed as it moves to its 2nd phase. This has implications first and foremost for the CP’s vision and mission (and subsequent strategy), all of which needs tightening, but also calls for clear, testable research hypotheses to guide and focus the research. The SC believes that the first process of initiating competitive grants without clear hypotheses and a research agenda was a root cause of this lack of focus.

The Panel recommended a critical re-assessment of the benchmark basins concept and choice of basins with a view to achieving greater focus. Management agrees to review the basin approach in phase 2, but noted that the concept has been useful to the program and clarified that the CP does not work on the entire basin in every project but the approach has helped to consider water availability issues both upstream and downstream. The Panel noted, however, with reference to projects within benchmark basins, that “the approach in most projects is not a holistic or integrated one in terms of how best to manage the land, water and biotic resources specifically within even the sub-basins of the nine selected basins for alleviating poverty and hunger, or for environmental conservation.” This is a strong indictment. The SC urges the CPWF to consider carefully this recommendation, including consideration of the current choice and number of basins and the evolving experience of the basin focal projects. The results of this re-assessment should guide future project selection and should allow for value creation from the current project portfolio. Innovative basin analyses could tie the projects together better and identify priority areas of research which are likely to best support achievements of the CPWF objectives. Ideally, this should have been carried out at the beginning of the CP.

Thus as a condition for the continuation of the 2nd phase, the SC recommends that the CPWF develop a new strategy with a clear focus on those parts of the complex issues of the “Challenge” it intends to address in the 2nd phase and elaborate how it will do so. This new document should be discussed and approved by the SC at SC09. It is important that clear research gaps are identified on which a call for proposals and/or commissioned research is based. The anticipated research outputs should be clearly defined and a priori should be IPGs. This will avoid having to extract IPG-nature outputs retro-actively as was the case in phase 1.

More in-depth analysis by the Panel would have been helpful to the SC on the critical question of the “added value” of the CP. The Panel recommends careful attention to this aspect in the evaluation of the 2nd phase. As stated by the Panel, during that evaluation the “added value” components should be assessed within the context of a marginal analysis approach and should be clearly linked to CPWF’s efforts. It requires the ex post evaluation to consider results thus far achieved (against costs) with and without the CPWF. This will be a challenging exercise because many of the CPWF projects have antecedents in their “home” Centers. Hence, it will involve projecting the fate of research projects that had been running up to the time the CPWF commenced, had they not been successful in securing CPWF funding to keep going. In fact, this analysis is at the heart of validating the CP “added value” concept. In lieu of a formal analysis, the Panel attempted to consider the added value of the CP through different means and often cast the “counterfactual” as a comparison with an individual Center, particularly IWMI. Thus, issues such as “how has the CP developed linkages to other partners and other Centers” and “how has the CP added more donors” have been addressed to some extent. In the Panel’s view the strengthened linkages between CGIAR Centers, NARES, ARIs and NGOs is perhaps the most obvious and important “added value”. One other measure could have been “how successful has this CP been in bringing together the water and the food sectors of research?” There is evidence within the report that this has not happened. As this was one of the major objectives of the CP – bringing together partners from different sectors to address water and agriculture related constraints holistically – it represents a major deficiency and one which merits serious attention in phase 2. In this context the SC notes that a number of Centers are now formulating their programs on a catchment or landscape basis. This orientation may offer good scope to integrate better and to align various Center programs via the CPWF. To realize on this promise however may require that Centers be encouraged to use the same benchmark basins as has been identified by the CPWF. Perhaps using some of the CPWF funding as an incentive to encourage this integration, in lieu of competitive grants, would be worthwhile?

The Panel found that a number of projects have very strong links with their “parent” CGIAR Center and that it was difficult to determine what made them different from Center-based projects. For instance, PN 7, PN11 and PN 16 are all IRRI-based projects that have rice breeding at their cores and have well established IRRI antecedents. That is not to question these projects’ merits but rather to question the impact of CP funding as opposed to the operation of the CGIAR Centers in a “business as usual” setting. This is an important facet of project and program evaluation. One point of difference between these CP funded projects and their “parent” projects is that they involve more extension activities and a greater spread of applications across the benchmark basins to show the applicability of fundamental results. While this is no doubt a valuable contribution, it is more of an extension contribution than an IPG research contribution and needs to be assessed in that light from the CGIAR perspective. With respect to quality and relevance of the research, the Panel felt that research methods developed by some projects did not appear to have been subjected to rigorous assessment. For instance, PN50 (Multi Scale Mekong Water Governance) gives some impression of being an advocacy project rather than an analysis project. Participatory decision making involving networks is taken a priori by the research team as being “good” and the project then sets about to establish this style of governance. The research process of establishing hypotheses from theory and then testing those hypotheses in the specifics of the prevailing context has not been followed. The consequential danger is that the research “findings” will be rejected by policy makers with vested interests that are counter to participatory action, because of their subjectivity.

The publications reviewed for this assessment (self-selected by the CPWF) are mostly descriptive. While for some projects this is indicative of their stage of development, even review papers can conclude with an examination of the relevance of the work thus far conducted to the overall research goals. This element is absent in many of the papers reviewed.

The Panel also called for a more proactive documentation, especially in the preparation of synthesis reports for target audiences on specific issues resulting from the research. CPWF Management agrees with this recommendation and, related to it, the need for increasing the visibility of the program outputs and developing a clearer publication strategy. The CPWF also recognizes the need for a stronger uptake strategy. Independent ex-post evaluations were proposed by the Panel for all projects rather than attempting to measure ultimate development impacts at the global level, a recommendation the CPWF agrees with, as does the SC.

In sum, subject to the development of a well-conceived and more tightly focused strategy and implementation and monitoring plan for phase 2, as well as a clear exit strategy and timeline, the SC endorses continuation of the CPWF. As a next step, the SC looks forward to reviewing and endorsing a Phase 2 Plan for the CP at SC09. The Plan should focus on the deficiencies as noted in the ER report and highlighted by the SC in this commentary. As it re-defines its vision and overall objectives, sharpens its focus (including the benchmark basin concept), and establishes and implements a more rigorous internal M&E system, the SC is confident this CPWF will be able to generate highly relevant and good quality research outputs that can effectively contribute to CGIAR goals.

Governance and Management - related

The Panel recommended some far-reaching reforms in the way the CPWF is governed and managed (Recommendations 24-29). For governance, this includes, among others, recruiting an independent, senior and well-respected professional to chair the CSC (without institutional ties to the CP), the establishment of an eight-member Executive Committee (with the DG of IWMI a non-voting member), and transforming the current expert panel into a Scientific Advisory Panel with the requisite level of

expertise. After these initial steps, the Panel believes the CPWF could embark on a more thorough reform of its governance. For management, the Panel believes that the CPWF Management team should be strengthened to assume a more proactive role in program implementation. An iterative approach to both governance and management reforms was proposed to minimize disruption to the program. In its formal response to the governance-related recommendations, the CSC agreed to the need to reform and improve governance and management arrangements. Although it believes the recommendations are a good starting point for discussions on reform, the CSC does not agree with the specific structure proposed by the Panel. The proposed structure raises several outstanding concerns that relate to: (i) the independence of the CPWF from the CGIAR, (ii) inadequate representation of IWMI, and (iii) the potential creation of a new "CPWF institute" that could lead to more competition rather than better collaboration across CG centers. The CSC feels that more time is required for consultation. It is currently debating what structure might be most appropriate for the CP and has outlined a process for developing a new governance structure between now and April, 2008. The CSC emphasizes that, with careful consideration and after discussion with CPWF partners, it will be able to identify a win-win solution that strengthens CPWF governance, maximizes cooperation between the CPWF and CG centers and thus minimizes the risk of the CPWF competing for funding with IWMI. The SC considers this response by the CPWF a prudent one, but concurs with the Panel on the need for reform in governance and management of this CP, which, in its current form, is in contrast with the HP-CP and the SSA-CP, and thus warrants more discussion and deliberation at the System-level as well. The Council looks forward to receiving prior to its next meeting in March/April 2008 a CPWF phase 2 plan that includes a revised governance and management structure. The Panel also made some recommendations about finance and accounting. In their view, financial management and reporting need considerable improvement and financial policies need to be strengthened in a number of areas. The SC is pleased to note the CPWF agrees with these recommendations."

Excerpts from the Response of CPWF to the Panel Report, 18 September 2007

- "The Review Panel believes that the results witnessed thus far, and expected over the short- to medium-terms, justify the establishment of the CPWF. Based on the past performance, neither the CGIAR Centres nor its Programme partners could have achieved these developments individually. The Programme has made individual CGIAR Centres more aware of the water-food nexus, and is already showing some benefits because of its multi-institutional, multidisciplinary and multi-sectoral approaches." (p. 6)
- "The Review Panel believes that after its recommendations are implemented both in the programmatic and governance-related areas, the CPWF can serve as a good model for greater interactions between national and international institutions and researchers. This is further likely to deliver implementable results in a cost-effective and timely manner." (p. 6)
- "Many of the projects have already started to produce results which could be used by the different categories of "clients" ... Based on the few CPWF projects visited by the members of the Review Panel, it appears likely that the cumulative outputs of its projects in all probability will increase exponentially in the coming months and years." (p. 46)
- "... the CPWF has made important headway in avoiding research effort duplication through the collaboration it has ensured." (p. 32)
- For NARES, the CPWF has provided an opportunity to be important, equal and sometimes leading partners in projects that affect their countries, thus helping south driven research that is a policy of the CGIAR Science Council (p.29)

- “The CPWF, however, has a key comparative advantage vis-à-vis other internationally supported research activities Because of the political constraints, sensitivities and technical and managerial complexities the support of the CPWF will undoubtedly enhance the research facilities and capabilities of national researchers and institutions, .. [who] also are likely to produce good results which may go a considerable way to meet the CPWF goals.” (p. 37)
- “These in-depth discussions were candid, and were conducted with a constructive and holistic spirit.” (p.17)

The following CPWF management comments follow the order and sections of the report.

2.1 Objectives

2.3 Relationships between CPWF and the CG Centres

3. Recommendation. Thus, the Panel recommends that the CPWF should be maintained as a time-limited entity that precipitates greater levels of collaboration between the Centres and other research and development partners.

Agreed. CPWF also agrees with the Panel that the comparative advantage of CPWF lies in its trans-disciplinary and trans-regional partnership with multiple institutions and in its emphasis on projects intended to lead from research towards development

4. Recommendation. The Panel recommends that more collaboration should be a prerequisite for the continuation of many existing CPWF projects and for newly commissioned research work.

Agreed, interpreting the Panel recommendation to refer to collaboration among projects, since there is already a high level of collaboration within each project. Where there are on-going contracts resulting from competitive selection, CPWF will continue assisting projects to identify opportunities for promoting collaboration, since contract agreements cannot be unilaterally altered. In some cases this will need to be supported with additional funding, as in existing project leader meetings, CPWF International Fora and travel grants to promote cross project interaction and sharing. For newly designed activities, a tighter conceptual framework, targeted calls for proposals and commissioned research will increase collaboration and synergy.

2.4 International public good aspects

6. Recommendation. The Panel recommends that the Science Council should give stronger direction as to what constitutes IPGs, in terms of the continuum, which would assist in the definition of research objectives and the reinforcement of that delineation through the course of the Programme.

Agreed. We believe that CPWF is helping build and understand the practice of producing IPGs in natural resources management research. We perceive, at present, that all development is local, and thus all research for development must work in contact with the local scale at many stages of project development, implementation and evaluation. It is the broad applicability of methods, knowledge, ideas, tools and technologies across parts of basins, countries and regions that makes them IPGs.

7. Recommendation. The Panel thus recommends that the potential for the CPWF involvement in forming public-private consortiums to enhance the international public goods aspect of research should be investigated.

Agreed that this potential should be explored. We note that the Panel's text objective to "Transform public good research findings into profit making development schemes." might be appropriate in other programs for IPG such as production of seed of improved varieties, development of value-adding industries based on new crops, or marketing of diversification crops. In the CPWF agenda, there may also be opportunities for private based services to advise on or invest in water or infrastructure management for food production. It is, however, harder to envision how profit-making schemes would be implemented for most CPWF research, for example on governance, environmental flows, fostering negotiation, and so on.

2.5 Focus of CPWF projects

8. Recommendation. The Panel recommends that the politics, law and economics of transboundary basin issues be research areas that are more vigorously pursued in the CPWF.

Strongly agreed. CPWF is already taking action in this direction which is a priority in phase 2 plans. Political aspects of water and agricultural administration were emphasised in the priorities for the CPWF's second competitive call and in an innovative session on the political ecology of water was included in CPWF's International Forum on Water and Food. These build on the work of first call projects that include the political dimensions of water governance within the Mekong River basin, from local to basin scale (project 50), governance in African basins (project 47) and the political interactions between communities, government and non-government agencies in the Andes (projects 20 and 22). Additionally, political and legal issues are addressed explicitly by projects 42 on groundwater governance and 48 on river-linking.

9. Recommendation. The Review Panel recommends a critical re-assessment of the Benchmark Basin concept, taking into account the evolving experience of the basin focal projects, as well as the current choice of the Benchmark Basins and with the assistance of experts external to the Programme Consortium. The Panel suggests a re-evaluation of how to work best within the basins. The new concept should mainly guide future project selection, but should allow for value creation from the current project portfolio. It may not be too late to do a basin analysis to better tie the projects together and identify priority areas of research which are likely to support achievements of the CPWF objectives the best. This, ideally, should have been carried out at the beginning of the Programme.

CPWF accepts the general thrust of this recommendation and agrees that the practical application of the basin concept should continue to be reviewed. A detailed proposal for doing this will be developed for the next phase, building on the Phase 1 investment in basin focal projects, that involves ten different international project teams, to find out whether and how the concept of basin integration and function can inform research. CPWF will develop a much tighter framework that links CPWF projects better with each other, and better with other ongoing activities.

3.2 Knowledge synthesis

11. Recommendation. The Panel recommends that the CPWF should attempt to develop a proactive process, instead of the current passive process, to prepare its future synthesis reports.

12. Recommendation. Hence, the Panel recommends that consideration should be given to produce a series of synthesis reports for specifically targeted issues and audience.

Both agreed.

3.3 Knowledge dissemination and application: Uptake of CPWF results

13. Recommendation. The Panel recommends that the CPWF builds into its partnership agreements the requirement for the national institutions to engage in application of research results to development. The Panel recommends that the CPWF builds a network of influential friends in a formal way.

Agreed. It is already a condition for selection of research proposals that specific links to development institutions be identified so as channel results in case of research success. Development of impact pathway analysis in all projects – now also a condition of submission for the second competitive call of Phase 1 – makes this more specific.

14. Recommendation. The Review Panel recommends that considerable attention now should be given to formulate and implement an overall uptake strategy.

Agreed completely that this is a high priority that, as the Panel also states, will require additional resources.

3.4 Assessment of publications and dissemination strategy

16. Recommendation. The Panel recommends that the CPWF establishes a publication strategy across all aspects of its activities to develop and encourage researchers to target high impact international scientific journals, as well as publications read by policymakers, and in national or regional journals that are read extensively by water and food professionals. Publications in language other than English should be considered whenever necessary.

Agreed. Management also notes and agrees with the Panel's comments that, while publication in high impact journals is important, they are not the best medium of publication for many types of end-users of CPWF research findings.

3.5 Capacity building

17. Recommendation. The Panel recommends that this aspect [authoritative syntheses of research results in specific subject matter areas for building up the knowledge base and capacity of professionals in water and food sectors all over the developing world] be integrated effectively into the CPWF's overall capacity building strategy.

Agreed. As the Panel states, additional resources will be required. CPWF is already developing theme based curricula - which collect case studies, research methods, research synthesis, and examples from across theme portfolios and across basins. The theme curricula are designed to be flexible, adaptable and transferable so that they may be used in both practical and academic settings, with the aim that others use them for capacity building of scientists from within and outside CPWF projects.

3.6 Evaluation

19. Recommendation. The Panel recommends that the CPWF rearranges and adapts its current set of visionary objectives into a set of global development goals to which the CPWF aims to contribute. It should be made clear, e.g., by establishing causal chains linking the internal programme objectives to these overarching development goals, in what way additional CPWF activities facilitate or enable players external to the Challenge Programme to work towards these goals. Based on a clear description of these activities, a reliable indicator system should be developed to measure the programme performance in terms of facilitation and enabling.

Both agreed, with the exception that there may be other, more suitable ways for the CPWF to measure success besides log-frames.

21. Recommendation. The Panel recommends to the abandonment of the notion to measure development impact of the CPWF on a global level. Instead, the CPWF should implement regular ex-post evaluations on reaching internal programme goals as defined above. This standard approach should be complemented by the assessment of the CPWF activities in enabling and facilitating development impact on the basis of its internal programme goals.

Agreed.

4. Governance and management

28. Recommendation. The Panel recommends that, under the leadership of the new CSC chair, an Executive Committee is formed, consisting of

- The new CSC chair
 - The chair of the CSC Audit Committee
 - 1 representative elected by the five Consortium CGIAR Centres
 - 1 representative elected by the 6 NARES and the one RBO Consortium members
 - 1 representative selected by the 4 ARI Consortium members
 - 1 representative selected by the 2 NGO Consortium members
 - 1 well-known international expert familiar with the management issues of some of the CPWF river basins and water-food interrelationships.
 - The Director General of IWMI or an IWMI board member as main host centre representative
- Search and election of independent representatives for the stakeholder groups (i.e. not belonging to any institution in that group) should be encouraged and the selection should be opened up to the whole CSC if no representatives can be found in reasonable time.

29. Recommendation. The Panel suggests that, after these initial steps, the CPWF embark on a more thorough reform of its governance under the leadership of the new chair and the Executive Committee. The key elements of this reform could be:

- The evolution of the Executive Committee into a CPWF board with full programmatic and budgetary functions and related accountability.
- The evolution of the present CSC into a stakeholder council that elects the board members and advises the board. The in-person meeting frequency for the stakeholder council can be lowered to e.g. one meeting every two years.

- Opening up of the Consortium to further key stakeholders leading to representation of all relevant CPWF stakeholders on the stakeholder council. The current roles and responsibilities Consortium members should be adapted accordingly.

Partly agreed. The CSC discussion brought out several issues concerning the proposed governance structure, with some members expressing the opinion that the structure is too independent of the CGIAR, the need for more representation of IWMI, that the structure could lead to more competition rather than collaboration, and importantly that there has not been enough consultation with the CPWF Steering Committee. In order to resolve these, a consultative process will be carried out as outlined below.

Excerpts from the Panel report

2.3 Relationships between the CPWF and the CGIAR Centers

“The Panel was requested to assess the added value of the CPWF compared to what might have been achieved by the CGIAR Centers, without the CPWF, especially by IWMI and IFPRI. Prior to the initiation of CPWF, IWMI conducted research on water management in a holistic, catchment wide context and both IFPRI and IWMI worked on agricultural water policy issues.

The 2002 Interim Science Council Working Document “Water and the CGIAR”² describes the situation well, and stresses that while IWMI were naturally foremost in water research, virtually all centers had an interest: “Actually, recent initiatives at the global scale by IWMI highlight the potential of the CGIAR to act as a focal point in some critical issues. Renewed efforts in water research are now undergoing in most, if not all of the other 15 CGIAR Centers”.

The document further stated: “While other international organizations are very active in many international initiatives, the CGIAR is one of the few that could contribute much needed research information in many world areas. The CGIAR must focus more on water in relation to the plight of the poor in particular.”

The initial proposal to establish the CPWF stressed the scale of change required for the CGIAR to make significant contributions to water and food issues. A shift was argued to be needed in two fundamental aspects. First, greater knowledge was deemed to be required about broad aspects of the food and water system. To achieve this, it was proposed to engage not just organizations with a sound knowledge of hydrology and water resources, but also those with considerable knowledge of agricultural systems, and how people change natural resource management. Second, it was argued that a change was required in the type and breadth of partnerships, engaging not just with the NARES that had long been associated with CGIAR, but many other types of actors including ARIs, international NGOs and some (though still insufficient) water research organizations. The goal was for the twelve CGIAR centers to be engaged in competitive bidding that would bring new partners to the research task.

The development of the CPWF proposal in 2001 was led – and perhaps dominated by - IWMI and IFPRI. The five CGIAR Consortium Centers (IRRI, CIAT, World Fish, IWMI and IFPRI) contributed to the development of Background Working Papers. This rapid development of ideas in five themes required prior experience and knowledge of the water-food systems from many Centers and from ARIs and NARES. The broad agenda of the CPWF is illustrated by the experiences of ILRI. Livestock-water related issues do not appear to have been seriously considered by CGIAR or ILRI until the initiation of the CPWF. ILRI has recognized that the CPWF was the main driver that led it to establish a new sub-research theme

in this area which was later endorsed by the CGIAR Science Council. Through CPWF support, ILRI leads a successful research project on livestock-water relations in collaboration with other CG Centers, NARES and NGOs. This change for ILRI may not have been catalyzed by IWMI or IFPRI, acting either singly or together.

Beyond such developments, the modus operandi of CPWF is different from that of single CG centers. CPWF is a Research Program that has attracted and continues to attract a large number of willing institutions with a framework and a partnership to cooperate on research activities linking nature and society in an interdisciplinary and multisectoral environment. The comparative advantage of CPWF lies in its transdisciplinary and transregional partnership with multiple institutions.

Beyond CGIAR considerations, comments from several non-CGIAR research institutions indicate that the CPWF should not be viewed solely from the point-of-view of the CGIAR system. At present, just under half of CPWF funding (and 42% of competitively-assigned research funding) goes to CGIAR centers. For NARES, the CPWF has provided an opportunity to be important, equal and sometimes leading partners in projects that affect their countries, thus helping south-driven research that is a policy of the CGIAR Science Council.

A fundamental question that can be asked is if the CG Centers could have done what they are doing under the CPWF through their existing or enhanced partnership arrangements. The question can be answered in two ways: theoretically and practically.

In theoretical terms, the mission statements and objectives of the CG Centers are very broad. Conceptually, there was nothing preventing the CG Centers from undertaking research activities that are now being carried out under the CPWF individually, or in partnerships with others. Their mandates are broad enough to incorporate most of the CPWF activities. This can be illustrated by IWMI and CPWF mandates. The initial idea for the CPWF originated within IWMI, and it has been vigorously championed by IWMI. Therefore, not surprisingly, there are some similarities in the mission statements and strategies of IWMI and CPWF.

For comparative purposes, IWMI's mission statement in 1991 was expressed as: "To contribute to food security and poverty eradication by fostering the sustainable increase in the productivity of water through the management of irrigation and other water use in river basins." This was subsequently revised to focus on the water-food-environment nexus: "to improve the management of land and water resources for food, livelihoods and nature".

Hence, while the refinement of the IWMI mission statement has taken some emphasis away from water productivity, it still remains as a prominent feature of its focus. Similarly, the CPWF objective features water productivity but includes social and environmental elements. It is therefore difficult to tease apart the CPWF objective from the IWMI mission. Just as the IWMI mission is sufficiently broad ranging to be not only highly ambitious but also lacking as a point of reference for defining research direction, so too does the CPWF objective leave open a remarkably wide range of potential research areas.

It is not an easy task to define specific research directions when the objectives and missions of the two could logically include a remarkably wide-range of research areas. In addition, both refer to river basins and water productivity, explicitly or implicitly. In practical terms, while the mission statements and objectives of IWMI and CPWF have considerable similarities, the approach used by the CPWF to develop projects and the nature of some of its projects have been different. The CPWF projects have tended to

be more multi-institutional with an open call process for developing research projects, somewhat more diverse than IWMI in terms of issues considered, and more wide-ranging through involvement in the nine specific benchmarks basins. In addition, the CPWF has made a deliberate attempt to foster closer inter-linkages between the various CG centers and to increase their research interest in water-related issues. In addition, the CPWF is a time-bound program, lean in staffing and having no headquarters, whereas IWMI is a permanent institution with “normal” staffing levels, headquarters facilities, and regular staff members. Thus, the two are different in terms of how they have approached their tasks. In addition, IWMI is a full-fledged institution and the CPWF is a time-bound program. Indeed, the same argument can be extended to other CG Centers given that some of the current activities of the CPWF could well have been housed within the other CG Centers. This is especially true given that responsibilities for CPWF Themes have been assigned to five separate CG Centers. For instance, can Theme 1 projects be equally well carried out under IRRI auspices as they are under the CPWF? And Theme 5 projects by IFPRI?

To address this issue, the motivation for the establishment of the CPWF needs to be examined. The opportunity to establish the Program can be viewed as being driven from two perspectives. The first is that research into Water and Food would be advantaged by drawing in more skills/experience than those that were available to IWMI, including those provided by partnership arrangements with NARES and ARIs. This is a supply side issue. For this to be the case, the structure of the CPWF must have been sufficiently different from IWMI's to allow a change in the supply of research services. The implication of that case is that IWMI's existing partnership strategy was not sufficiently well developed to pursue CPWF-type of activities. Nor were its staffing level and expertise sufficient to enable it to undertake such research projects. Resource constraints and institutional inertia may have constituted additional impediments. Hence, the need to establish the CPWF can be seen as a reflection of the inadequacy of the structures and operations of the existing CG Centers, most notably, IWMI.

It is likely that the existence of CPWF funding forced a more collaborative attitude onto Centers and collaborators and so established a precedent for taking advantage of available synergies. Given that the barriers to inter-Center collaboration are now being steadily broken down by the CP approach, time extensions to the CPWF, beyond what is proposed at present, should not be necessary because the Centers should be able to refine their partnership strategies in order to exploit the research synergies established by the conclusion of the program.

The second perspective on CPWF establishment motivation is from the demand side. The CPWF offered a new opportunity to “package” what IWMI was striving to achieve (Water-Food-Environment nexus) so that donors would be more attracted to provide research funds. Discussions with donors revealed that there were differences in perceptions of funding possibilities across the two entities. The CPWF was seen as being more closely connected to the application of funding to projects intended to lead from research into development and so better suited to specific project funding. IWMI in contrast was, for some donors, the target for “core” funding at the broader conceptual level, especially in terms of international public goods aspect of research.

There are clearly possibilities of mixtures of both of these supply and demand perspectives to explain the formation of and incentives for the CPWF. For instance, with more partnerships and the synergies of co-operative research activities, donors are more likely to provide more funds. Accordingly, it is essential that the outputs and outcomes of the CPWF projects are demonstrably different from the products of other CG Centers. Otherwise, the donors may be reluctant to continue to support both. That would be the upshot of a situation in which the demand side perspective predominates.

The Panel recommends that the CPWF should be maintained as a time limited entity that precipitates greater levels of collaboration between the Centers and other research and development partners."

Challenge Programs (CPs) were explicitly (designed) and established as mechanisms to improve partnerships and increase delivery in the CGIAR.

On CPs Partnerships the Joint SC Secretariat/CG Secretariat "Synthesis of Lessons Learned from Initial Implementation of the CGIAR Pilot Challenge Programs. October 2004"² stated the following: "Lessons: The partnership should be determined by the nature, scope and scale of the problem and the research needs. That role of partnerships needs to be made clear in the planning stage. Although the CPs are explicitly expected to open the CGIAR up to partners beyond the traditional CGIAR ones, including leadership outside the CGIAR, the effectiveness of the CP must be judged on the added value of the partnership to engage in high quality science and deliver relevant scientific, time-bound outputs, not on the intrinsic value of the partnership per se."

Four Directors of CPs [J.Woolley (CPWF), J-M Ribaut (GCP), H.Bouis (HarvestPlus) and A.Adekunle (SSA-CP)] submitted to the Alliance of the Centers a contribution for the design of the CGIAR Consortium and the Mega Programs which describe "the CGIAR's Challenge Program Experiences: A Critical Analysis. A contribution to Consortium and Mega-program design "dated 6 February 2009. This report includes a section on Partnerships for research and another one providing independent advice on research, partnerships and development outcomes.³

The section on Partnerships of the **CPWF annual report 2007** includes the following statements:

3.2.10 Partnerships

"Diverse partnerships continue as an important feature of CPWF work. These relationships sometimes produce surprising results, in both the conduct and interpretation of the scientific research, through the interactions of partners of different backgrounds and approaches. The CPWF is working both from a study of the literature and analysis of its own experiences to determine what types of its partnerships are essential, and to create guidelines for developing and implementing partnerships in a cost-effective way. With the addition of the new projects contracted in 2007, a total of 213 different institutions officially participated in 65 CPWF projects, providing expertise through agreements established by memoranda of understanding with the project lead institutions. Present estimated distribution of project funding: 45% NARES, 41% CGIAR, 9% ARI, 5% NGO. Thirteen small grants, two special Danish-funded projects and two first call projects have concluded; so far 20 projects have been granted no-cost extensions of from four to 13 months.

The CPWF achieved recognition for its innovative use of interdisciplinary, cross-sector partnerships in research. After the Program was invited to present a paper at the CGIAR Science Forum, run in conjunction with the CGIAR Annual General Meeting in December, EIARD, the group of European donors (including almost all CPWF donors and some prospective ones) stated: "The value added by the CPWF is

² http://www.cgiar.org/pdf/agm04/agm04_cp_lessons.pdf

³ http://www.waterandfood.org/fileadmin/CPWF_Documents/Documents/Management_Documents/Critical_Analysis_of_CP.pdf

the very important network 'capital' that is created. It means that many organizations are involved in the program and NARS consider the CPWF to be more equal in its partnership approach than other CGIAR led programs. Through the competitive process linking partners, especially in transboundary work, the CPWF has been able to tackle issues that would have been impossible to cover by individual CGIAR centers or NARS." The guidelines for competitive calls continue to emphasize partnerships and teams; which was reflected in the scoring of the criterion used by External Review panelists. Program thinking on the design of competitive calls and contract requirements continues to evolve as more is learnt about the dynamics of project teams and how 'process' elements of a research program can influence the establishment of durable teams. Past reports have shared data on the rich and diverse partnerships formed by the CPWF that sometimes produce surprising results in the conduct and interpretation of the scientific research through the unexpected interactions of partners with very different backgrounds and approaches.

The CPWF collated a number of 'lessons learned' during 2007 on various aspects of the program. The lessons that relate to partnerships and teams are extracted below:

- Partnerships must be developed only when they are likely to increase the efficiency of research for development; this is especially prudent where challenges are interdisciplinary and/or cross-sectoral.
- CPWF opened up opportunities for national institutions to participate as equal partners, contributing to and even leading research projects.
- It is easier to maintain existing partnerships—which could be taken to new levels of interaction or cover new content—than it is to build new ones. New partnerships need planning and monitoring through network analysis and may then yield more innovative inputs than existing partnerships.
- Dispersed scientific networks in a Challenge Program (CP) can work via virtual communication; however, personal face to face contact is important, especially for interactions aiming to discard pre-conceived notions or assumptions. Communication tools such as a regular newsletter can help people identify with a community of practice. CPs need to develop—and indeed are developing—the practices of using a virtual equivalent of 'brainstorming' and initiating spontaneous meetings to deal with specific urgent issues.
- Investment in networks should be regarded as investment towards more effective science and not as a transaction cost. It is not usually feasible to foresee exactly what the role of each partner will be in a partnership, although there are common sense rules on how to limit duplication among partners.
- Partnership maintenance requires tact and negotiation. It is easier to find an effective role for all partners if responsibilities are assigned at different levels, such as project activity, project oversight, basin or theme coordination, program management.
- Members of national and international institutions within a CP team can guide each other about the characteristics and needs of other partners."

As a representative of IRD in the Steering Committee of the CPWF - before I joined the CG Secretariat - **I participated in the second international forum (IFW2)** organized by the CPWF in Addis Ababa November 10-14, 2008 which theme was "Partnerships for Change, Science for Development ". The following notes are extracted from the Back to Office Report I shared with colleagues in the CG Secretariat at that time:

"One of the major innovation of IFW2 was probably the Policy and Practice Panel (PPP) of six members which observed and analyzed all the presentations and plenary sessions and came up with a synthesis of key messages presented at the wrap up session of the plenary, insisting on the difference between two

models of doing business for the CGIAR a) the traditional IARCs business model (although slightly modified by networking/partnerships activities under the SWEPEs, but still at the margin of engaging into full partnerships), and the model promoted by *the CPs and the CPWF in particular, as a transformative force* promoting non-linear change and a new model of knowledge production in agricultural research for development with new characteristics which include: moving from multidisciplinary to inter-disciplinary then transdisciplinary approaches; research into use/integration in the field; opening up communities of practitioners; systemic approaches; upscaling and outscaling; local/global coupled systems ; research helping to change power relationships between partners/beneficiaries, etc.

The panel identified some overarching issues and made recommendations related to the four new CPWF Objectives: 1) Pro-Poor Development outcomes - the CPWF should do more to contribute to policy processes with tangible and practical outputs, thinking through how it can contribute to existing development initiatives/organizations such as NEPAD/CAADP; 2) Scientific outputs conceptual clarity - imperative that Basin challenges drive research and topics, integrating social dynamics and opportunities as key elements of new projects design, and considering linkages to the broader agricultural context (nutrition, health, gender...); 3) Fostering a more effective and integrated process of collaboration in water-food research among CG Centers, and between them and other research partners - make Phase 1 results known and used by stakeholders and end-users through the networks and learn within Basins from other CP projects; 4) Improving partnerships between the research community and development institutions (including policy-makers and NGOs) over issues of food and water productivity - focus on "niches" of comparative advantage and select strategic partners, as well as ensuring that results are understood by non-scientists. Finally, the PPP recommended establishing a CPWF Policy Advisory Group for Phase two of the Challenge Program."

B. Harvest Plus, 1st External Review report, January 2008

Science Council Commentary on the 1st External Review of the Harvest Plus Challenge Program
September 2007

Program-related

"The SC agrees with the panel that HarvestPlus is an exciting and value-adding initiative dealing with three major micronutrients essential to tackle micronutrient deficiency (Iron, Zinc and Vitamin A), with major potential impacts on nutrition and health, especially on the poor in low and middle income countries. The Council agrees with the findings of the report concerning need for more focus on the intended objectives, and strengthened collaborations with NARS as end users of HarvestPlus products, involving them early-on in research planning.

The SC endorses the Panel's recommendation to enhance the use of both conventional and transgenic breeding for biofortification of crops with Zinc, Iron and Vitamin A. The SC acknowledges that achieving similar enhancement results for Fe and Zn may be somewhat more difficult than the early successes achieved to date for Vitamin A. In particular, the SC strongly concurs with the Panel's exhortations that HarvestPlus make more use of QTL analysis, and apply state-of-the-art molecular markers to speed delivery of improved varieties. The SC also agrees with the Panel's concerns regarding intellectual property issues of the Challenge Program, especially in the case where both conventional and transgenic breeding are used. Such IP issues may be exacerbated because Harvest Plus has a large number of partners and is itself not a legal entity.

A major point of discussion has been Recommendation 3 of the Report which talks about the implementation strategy (i.e. the deployment, testing of adoption and the impact of nutritionally enhanced varieties). This has been an important part of the HarvestPlus Program from its inception. It is an integral part of the proof of concept of the biofortification approach. Whilst enhancement may be brought about through breeding research, in moving to deployment there will be a need to consider the whole chain from production to consumption as there are many steps at which the quality of foods can be affected either positively or negatively. The Panel urges the CP to involve NARS at an early stage of the development of the implementation and testing, a point with which the SC concurs. The Management Response notes that breeding and enhancement are carried out both through Centers and collaborating national members of the Consortium according to their strengths in different commodities. Reaching end-users will involve all parties in the target countries, including agriculture and health institutions. This is a major task for HarvestPlus in facilitating and evaluating actual implementation by national partners..... The SC notes the Panel's concern that in order to have micronutrient-dense genetic material adopted, it will be necessary to forge stronger links with conventional breeding programs that add evident traits of value to farmers, to the cryptic micronutrient ones."

Response of the HarvestPlus Program Management Team to the External review

"1. Project Objectives and Justification, Specific Target Populations and Expected Extent of Impact

Should HarvestPlus undertake research to quantify the interactions between biofortification and other public health interventions?

While we agree that addressing all of the many causes of death and disability is the ultimate goal of development, the purpose of HarvestPlus is to develop and test the tools of one specific intervention. Therefore, HarvestPlus does not believe that it should bear responsibility to define and measure the benefits of comprehensive packages of interventions, encompassing micronutrients, prevention of infectious disease, safe and adequate water supplies, and so on. Research on the combination of these interventions would best be designed and tested in the context of national health and welfare programs.

Again, it may be possible to be cost-effective and opportunistic in investigating the magnitude of these interactions in the design of particular studies. Additionally, the HarvestPlus nutrition research program has already begun to include, and will continue to include, considerations of other health conditions that may modulate the impact of biofortified staple foods on nutrient absorption and status (e.g., infection status of individuals, and markers of intestinal health and permeability).

Specifically, we believe that HarvestPlus should not be expected to:

- Quantify the contribution of other causes of morbidity and mortality in addition to micronutrient malnutrition
- Demonstrate the effectiveness of biofortification only if other public health strategies are also implemented; the latter may not be feasible to implement on a sustainable basis and could therefore result in unrealistic benefits.
- Demonstrate the long term effectiveness of biofortification programs to reduce national rates of infectious disease or mortality once implemented on a national scale. It is noteworthy that attributable risk due to micronutrient deficiencies and the impact of interventions such as

fortification have been derived using empirical data largely from controlled efficacy trials of single micronutrient interventions. Thus far these have not relied on effectiveness studies, nor have they included multiple public health interventions such as improved breastfeeding, and prevention of infectious diseases. True effectiveness studies of micronutrient interventions are as yet uncommon, yet micronutrient interventions such as supplementation and fortification are still considered to be cost-effective interventions to reduce morbidity and mortality in at risk populations (1.1.1, and Annex 7 of the External Review report).

2. Breeding Strategy

Recommendation 6. The Panel recommends that the CP strengthen collaborations with others or explore tripartite arrangements (CGIAR Centers, extra CGIAR Centers and HarvestPlus CP). The Panel considers that there is clear need to strengthen the breeding program, in terms of applying the use of modern biotechnology in assisting the breeding process. The progress reports need to include key milestones indicators that serve to document the achievements necessary to further increase breeding efficiency by using the relevant biotech tools (Genetic mapping, QTL and MAS).

Recommendation 7. The Panel recommends that the science base effort necessary for efficient breeding methodology should be strengthened. This is essential to secure crops with enhanced nutritional traits that will also combine superior agronomic traits, this approach is needed to establish a clear economic advantage in growing the new crops and thus assure sustainable use of the crops developed by HarvestPlus.

Recommendations 6 and 7 can best be addressed simultaneously. We concur with these recommendations of the Panel. Several of the points raised already are part of the HarvestPlus agenda. HarvestPlus is endeavoring to develop and integrate molecular tools into the breeding process. Activities include (i) simulation/modeling of marker assisted selection (MAS) and assessment of cost/benefit of molecular marker development, and (ii) implementation of (MAS) for selected HarvestPlus crops.

Assessment of cost/benefit of molecular marker development

Related HarvestPlus research is then addressing cost assessment in germplasm product development, a major knowledge gap in public sector breeding efforts. HarvestPlus teamed with John Brennan, a leading expert in this field, to develop a program for Cost Assessment of Research and Plant Breeding Options (CARBO H+), building on a previously developed program applied for wheat at CIMMYT. The program is expected to cover all crops, breeding stages, and conventional and marker assisted selection. Prototype versions for wheat, rice, maize, bean and cassava are already available. CARBO H+ in combination with simulation allows consideration of all primary factors related to breeding efficiency (not only nutrient content) and development of strategies based on their contribution to genetic progress and benefit/cost. MAS must take into account all breeding goals (high yield, pest resistance, etc) in defining crop biofortification strategies which maximize genetic gains and breeding effectiveness -- which combine all the attributes which are critical for adoption by farmers such as agronomic performance and by consumers such as sensory traits. For most, if not all the range of traits relevant for farmer adoption, molecular markers are not yet available at CGIAR Centers and may not be available in the near future. Consequently, effectiveness in product and impact oriented crop biofortification is also driven by genetic knowledge gains for these traits and strategies to reduce time to market such as rapid generation advancement techniques, high-throughput screening techniques/diagnostics, generating micronutrient environments, computer-assisted design of crosses, and spatial experimental designs. For example, NIR high-throughput diagnostics allows, at low cost, estimation of micronutrient levels in crops

and a wide range of other traits and compounds (among these compounds associated with bioavailability) and permit using selection indices and taking into account correlations among these compounds in selection. The NIR technology for micronutrient pre-screening has been further developed under HarvestPlus, and implemented for several crops at CIP, CIAT and CIMMYT. Plans are in place to expand the use of the NIR technology to all HarvestPlus crops, and participating CGIAR Centers and NARS partners. Defined milestones are on target to be met in 2008 and will be highlighted in future reports. A publication on CARBO H+ is planned for Crop Science.

Collaborative Arrangements for MAS

Several teams are currently collaborating on MAS for specific crops with the CGIAR Centers responsible for these crops. In some cases, output from the collaborative research eventually can also be directed to development of transgenics:

- Wheat – MAS: Ismail Cakmak, Sabanci University, Turkey; Preben Bach Holm, University of Aarhus, Denmark; Hugh Wallwork, University of Adelaide, Australia
- Maize – MAS: Torbert Rocheford, University of Illinois, USA;
- Rice - Gene Discovery for MAS and/or Transgenics, Janette Palma Fett, University Federal do Rio Grande do Sul, Brazil; Naoko Nishizawa, University of Tokyo, Japan; Alex Johnson, University of Adelaide, Australia

More upstream and cross-cutting genomics research by Peter Beyer (provitamin A carotenoids), Michael Grusak (iron and zinc), and Dean Dellapenna (provitamin A carotenoids) contributes to MAS for several crops. Such collaborative arrangements can be strengthened in the future as required, for example for cassava.

Implementation of MAS for HarvestPlus crops

In the current strategy, molecular marker development, routine MAS, and marker assisted backcrossing are intrinsic parts of the breeding strategy (a crucial enabling technology). Due to the integration of HarvestPlus crop teams with breeding and MAS at the CGIAR centers, the program is able to leverage complementary activities. Therefore, the present strategy reinforces the mechanisms necessary for a closer interaction between biotechnologists and breeders. Key milestones describing the above activities have been defined, met, and summarized in reports. Publications are being prepared. In future reports, more detailed milestones and accomplishments towards these milestones will be highlighted and communicated.

The Need for Superior Agronomic Traits

Central to HarvestPlus strategy is the incorporation of micronutrient density into adapted, superior agronomic backgrounds with added-values from higher productivity, better tolerance to abiotic and biotic stresses, better end-use quality characteristics and production economics, and combinations of those. For example, biofortified elite bean lines combine high iron with drought tolerance in commercially accepted market classes. This has resulted in the selection of more than sixty lines by farmers in Kenya, DR Congo, Rwanda, Burundi, Malawi, Madagascar, Uganda and Tanzania and the promotion of lines developed as part of the HarvestPlus program to National Performance Trials in Kenya and National Variety Trials in Ethiopia.

HarvestPlus research thus far indicates that micronutrient density and yield can be combined. Micronutrient-dense breeding products developed under HarvestPlus outperformed or were competitive with commercial checks for maize (Nigeria), cassava (DR Congo, Brazil), bean (several

African countries) and orange-fleshed sweet potato (Uganda); further evidence exists for rice (the Philippines), soft wheat (China), Lentil (Syria, Ethiopia, Bangladesh) and pearl millet (India).

3. Dissemination Strategy

Recommendation 9. The Panel strongly recommends that the CP consider the NARS as the end users of its product (nutritionally enhanced crops) and thus include the NARS from the early stages of development to the implementation in pilot projects with farmers.

Recommendation 3. The Panel recommends that the implementation strategy be based mainly by establishing partnerships with NARS or equivalent national bodies at an early stage. The Panel considers that this model is the best way to assure a cost effective and sustainable implementation. The Panel considers that the CP should not primarily be concerned with implementation; the CP should stay within the proof of concept testing mode, evaluating and facilitating the actual implementation by national partners.

Recommendation 8. The Panel recommends that further steps be explored to ascertain that the final product be eventually acceptable to the target groups, namely the farmers that are going to be growing the crops and the consumers of such nutrients-rich staples. Without their early buy-in, there is always the prospect of such products not being acceptable to the intended users.

Recommendations 9, 3, and 8 can best be addressed simultaneously. We accept all of the points in these three recommendations, with the possible exception of the last sentence of recommendation 3 as discussed below.

The “Reaching End Users Conceptual Framework”

In broad terms, three things must happen for biofortification to be successful. First, the breeding must be successful as defined in step (i) above under 1. Project Objectives and Justification. Second, the retention, bioavailability, and efficacy studies as defined under steps (ii) and (iii) above must be successful, and third the biofortified crops must be adopted by farmers and consumed by those suffering from micronutrient malnutrition. In HarvestPlus, this third step is addressed under the rubric of “Reaching End Users,” or REU. HarvestPlus has developed four REU typologies, as outlined in the diagram below. REU will be more difficult and expensive depending on (i) whether or not the nutrient trait is invisible or visible and can piggyback on a superior agronomic trait and (ii) the extent to which institutions and markets are strong and conducive to the rapid spread of new crop technologies.

In the case of visible nutrients (that is, where provitamin A carotenoids change the color from white to orange), it is recognized that some type of nutrition education program (in conjunction with high profit, good agronomic qualities) will have to drive adoption (“demand creation” in the diagram above). The above framework is being applied to the dissemination of OFSP in Uganda and Mozambique. The cost-effectiveness of alternative means to provide information on the consequences of and ways to overcome vitamin A deficiencies are being assessed. Lessons learned/best practices will be derived from a comparison of these two contrasting case studies. With this as background, we very much concur that all steps be explored “to ascertain that the final product be eventually acceptable to the target groups, namely the farmers that are going to be growing the crops and the consumers of such nutrients-rich staples.”

Participation of NARS

We recognize that a particularly vital element of any REU strategy is that the biofortified varieties are just as high-yielding and profitable as the best lines otherwise available to farmers. Therefore, they must be well-adapted to local growing conditions. In this regard, we agree that it is important to work with NARS as collaborating partners and as key entry points for delivery of the biofortified crops.

However, in each country it must be a coalition of implementing agencies in agriculture and health and their “enablers” (those who at higher levels administer those who implement) who must work together to make the third step happen of adoption by farmers and intake by malnourished consumers.

NARS have been included in early stages development in projects with farmers since HarvestPlus commenced. Deployment and implementation strategies are an integral part of product concepts.

On the following page is a list of collaborating NARS who have received HarvestPlus funding and who have attended HarvestPlus crop meetings:

Degree of Participation of HarvestPlus in Dissemination

A key question raised in recommendation 3 is the extent to which HarvestPlus should get involved directly in the REU process. The second part of recommendation 3 implies that HarvestPlus should focus on breeding and nutrition studies, and be marginally involved in REU. We think we have some disagreement here with the Review Panel. First, it must be emphasized that collaborating partners (CGIAR Centers, NARS, and a number of other institutions) do all the work of development and dissemination of biofortified varieties – activities which the relatively small HarvestPlus staff endeavors to coordinate through contracts which are funded by a consortium of donors and which are issued to partner institutions. This cuts across the three broad steps described above of breeding, establishing efficacy, and dissemination. For each biofortified crop, HarvestPlus believes that it is important to demonstrate feasibility and success in 2-3 target countries. We believe HarvestPlus should assist in coordinating, identifying and relieving bottlenecks, and learning lessons from dissemination efforts. Importantly, this involves taking leadership in raising the funds (only a part of which may be channeled through HarvestPlus to collaborators) so that national-scale REU activities can be realized in selected target countries.”

Type of Collaboration	Phase 1 Crops					
	Rice	Maize	Wheat	Sweet-potato	Beans	Cassava
Received HarvestPlus Funding for Breeding (Attended HarvestPlus Crop Meetings)						
	Bangladesh	Ghana	India	Mozambique	Kenya	Ghana
	Indonesia	Guatemala	Pakistan	Uganda	DR Congo	DR Congo
	Philippines	Zambia	Kazakhstan	Kenya	Burundi	Togo
	Vietnam	Ethiopia	Turkey	China	Malawi	Guinea
	China	Brazil	China		Uganda	Brazil
		China			Tanzania	
					Brazil	
Funded for Germplasm Evaluation/Receive Germplasm and/or Attend HarvestPlus Crop Meetings						
	India	Angola	Uzbekistan	Tanzania	Rwanda	Benin
	Nepal	Nigeria	Kyrgyzstan	Ghana	Madagascar	Sierra Leone
	Thailand	Kenya	Tajikistan	Ethiopia	Angola	Nigeria
		Malawi	Azerbaijan	Rwanda	Lesotho	Colombia
		Mozambique	Georgia	Nigeria	Cameroon	
		Zimbabwe		South Africa		
		Mexico		India		

		South Africa		Indonesia		
		Cameroon		Zambia		
		India		Madagascar		
		Nigeria				
Co-Funding from National Sources						
	India	India	India			
		Brazil	Brazil	Brazil	Brazil	Brazil
	China	China	China	China		

Excerpts of the Panel Report

4. Partnerships

“Considering the critical nature of partnerships for the HarvestPlus CP the Panel has placed several of the key issues relative to partnerships in a separate chapter. In general these items address the need for stronger partnerships in order to allow the CP to concentrate in where it adds value. The Panel also examined potential need for partnerships beyond the CGIAR system that can provide synergies and help advance the HarvestPlus objectives in a cost effective way. The need to strengthen monitor and evaluation is included under chapter 5.4.1 Should the program reach out more to new partners, e.g. NARES and outside CGIAR?”

HarvestPlus has a total of 46 institutional partners that, at some point in time, have collaborated with (and received funds from) the Challenge Program (Annex 9). Based on total cash disbursements for research from 2003-2006, the following ranking in terms of research funds received per institution can be compiled. As can be seen from this chart, HarvestPlus focuses its funding on a group of 5 to 10 key partners, receiving 52% (top 5) and 80% (top 10) of the total research funding of 25.2 million US\$ from 2003-2006.

Table 4.1. Partner ranking in terms of funding for research

Rank	Name of Institution	Research Disbursement share 2003 – 2006	Research Disbursements 2003 – 2006 (in mill US\$)
1	IFPRI	16%	4.1
2	CIP	10%	2.5
3	CIAT	9%	2.3
4	CIMMYT	9%	2.2
5	USDA	8%	2.0
6	IITA	7%	1.8
7	IRRI	6%	1.5
8	University of Adelaide	6%	1.4
9	Michigan State University	5%	1.2
10	University of Freiburg	4%	0.9

The Panel suggests that the HarvestPlus program strengthen partnerships with research scientist conducting genomic research on the phase I crops. This is needed to obtain the mapping of nutritional and agronomic desirable traits. The mapping of QTLs and or specific genes linked to these traits and the respective molecular markers should further increase the chances of success and the efficiency of the breeding effort.

There are several research networks in place addressing exactly these topics (the USDA is investing on wheat and rice, addressing mainly agronomic properties see section 4.3). The CP could contribute by adding the corresponding nutritional traits to these crops and gain in the process since there is no need for exclusivity since the research is funded with public resources it should be made available to those in greatest need.

The value for money of this CP should be more specifically targeted to the breeding of nutritionally enhanced crops that are effective in improving nutritional status and in defining the best way to reach end users mainly NARES and farmers only to facilitate the uptake as proof of principle. Partnership with NARES in the breeding effort would be ideal, as appears to be the case for India, China and Brazil. This will help to achieve sustainable results. The USDA wheat and rice (Coordinated Agricultural Projects) CAPs, which have similar objectives in terms of the science and the application of genomics to breeding programs offer a unique opportunity to increase value for money since the USDA effort at present is not focused on nutritional objectives.

The Panel considers that the effort to recruit the best science within the CGIAR but also make use of every possibility to synergize with existing efforts outside the CGIAR, promoting partnerships in competitive bidding (about 1.25 million or 5 % is done by competitive on the basis on cash disbursement of 25 M to the end of 2006) helps to strengthen the science. If the ground rules are set appropriately, the bidding process can help to establish partnerships that include developing countries, thus contributing to capacity strengthening and greater uptake by the end users.

4.2 What has been the added scientific value from the CP; in particular, by the partnerships represented by the CP?

“Breeding Objectives Subprogram”: US\$ 3.388.960

This subprogram was originally conceived as an upstream research effort that would investigate new strategies for optimizing the constraints to achieving HarvestPlus goals of breeding nutrient-dense staple crops. Specifically, first, it was intended to assist breeders to assay the bioavailability of Fe in breeders' lines using in vitro cell cultures and animal models; its second objective was to identify more efficient ways for breeders to enhance the nutritional content of crop plants such as exploring, among others, the role of inulin and carotenoids in promoting the bioavailability of Fe and Zn.

The key researchers are Graham and Stangoulis from Univ. of Adelaide (US\$2.047.415) and Welch from USDA-Cornell (US\$2.258.208). Ross Welch and Robin Graham are both distinguished researchers who have championed the case for bio-fortification since the 1990s and the Panel was informed that their work has been a source of inspiration and provided the scientific underpinning for HarvestPlus CP. It is in that context that at the outset of the program, a significant amount of non-competitive funds was disbursed to the PSNL in Cornell and the University of Adelaide respectively. Welch is leading an active research group trying to develop tools to make breeding more efficient by incorporating the two strategies mentioned above. His scientific leadership of the project is demonstrated by multiple key review articles on the subject and also by a steady publication record from the inception of the project until the present time; more than 20 articles have been published in reputable journals by this group. The Cornell Group under Welch is also involved in technology transfer and training of researchers particularly from developing countries such as China, Colombia, Nigeria, Thailand and Peru.

The Adelaide group (Graham and Stangoulis) list 20 publications in the 5 year period, many are not fully related to the HarvestPlus objectives. Twelve of them have to do with selenium toxicity, or selenium accumulation in wheat, with no mention of zinc, iron or carotenoids. Two of them are reviews or proceedings from meetings. Six publications address the HarvestPlus objectives. These publications are on the right track, with a QTL study on zinc/iron content in rice, screening methods for zinc/iron and carotenoids in crops and general diversity studies. However six out of twenty publications directly related to the HarvestPlus mission over 5 years is considered insufficient taking into account the over US\$2 M in funding.

Subsequent phone interviews with the Cornell and Adelaide groups reported that additional papers directly related to the HarvestPlus CP are in press or have been submitted for review. In addition the Adelaide Group is active in developing capacity building analytical laboratories for HarvestPlus collaborators in India, Nigeria, China, Mexico, Colombia and the Philippines. The technical assistance and support to the HarvestPlus crop leaders has been an important part of their effort. For instance, they have contributed to the establishment at CIAT of a laboratory to analyze minerals and contributed to the design of the equipment necessary to ensure there was no contamination of Fe and Zn during the sample preparation process. The Panel is appreciative of the scientific and leadership inputs from the Cornell and Adelaide Research Groups since the beginning of the HarvestPlus CP and looks forward to their contribution as the program expands and enters its new phase. These groups could play a pivotal role in training and capacity building of young researchers from developing countries.

Partnerships for breeding of “Phase I Crops”

Each major crop has received between US\$1.5 and US\$2.5 M over 5 years to enhance its nutritional quality. This is roughly ~US\$400,000 year/ crop to the different CGIAR institutions. The funds provided for each crop studied by the CP seems very reasonable for the objectives, considering that additional funding sources likely exist for each crop. Therefore, the US\$400,000 /year should be used specifically to implement strategies to increase carotenoids, zinc and iron contents in the grains.

While scientific output is not outstanding based on publication records, the measure of success in this case should not be research papers but the actual new crops, product of the breeding effort. The Panel is somewhat concerned with the limited documented novel scientific output over the initial 4 years. The publications of original research over this period directly linked to the HarvestPlus CP are limited in quantity and of rather low scientific impact if one assesses the ISI impact rating of the journals where these are published [wheat (5), maize (1), cassava (4), rice (0), beans (0) and sweet potato (1)]. There are multiple other outputs of research information such as proceedings from meetings, and abstract but these represent outreach and dissemination efforts that contribute little to the science base needed to support the breeding objectives and implementation of novel methods required by the breeding centers. After several years of funding, there should be more visible results for the different crops such, as QTL analysis and molecular/genetic maps with markers linked to the traits that will allow more efficient breeding.

This serves to highlight a potentially significant weakness in the science base of the CP, that is the clear need to strengthen the link between the basic research described under ‘nutritional genomics’ with the application tools necessary for a more effective breeding process. The Panel considers there is a need to incorporate molecular markers to assist the breeding process and make it more effective. A stronger link between the nutritional genomics and the breeding effort will strengthen the ambitious breeding objectives in terms of nutritional enhancement, agricultural superiority and economic productivity can be met without strengthening the link between the nutritional genomics and the breeding effort.

4.3 How do program costs (or cost per achieved output/outcome/impact) relate to other benchmarks? Is the cost per output/outcome/impact reasonable?

For comparison of this CP the Panel examined and reviewed the USDA wheat and rice (Coordinated Agricultural Project) CAPs, which have similar objectives in terms of the science and the application to breeding programs <http://www.uark.edu/ua/ricecap/> , <http://maswheat.ucdavis.edu/>. The USDA finances wheat and rice CAP projects in the US at a level of US\$ 4- 5 Million over a 4 year period (~US\$1.25 M per year/crop). This is divided into 15 laboratories, receiving less than US\$100.000 per year if you consider overhead (indirect costs):

- The CAP programs have 16 and 14 publications respectively in 2006-07, all directly related to breeding of wheat and rice respectively, QTL analysis, phenotypic characterization of accessions and generation of novel markers for traits of interest. This type of work is vital for the effective translation of basic science into breeding as it generates the necessary tools required for a more targeted breeding.
- For the wheat CAP project, there are currently 17 groups mapping populations, each looking at multiple phenotypes in to achieve an accurate mapping of the QTL linked to the specific traits. This is parallel to germplasm release and other work being carried out. These maps serve to yield new markers for yield, disease resistance, quality, etc that can be used directly in breeding within the next few years. Nutritional quality is not seen in the CAP program as a major aspect and was has not been incorporated in the objectives. This offers a unique opportunity for the HarvestPlus CP to explore synergism.

4.4 What has been achieved by the CP that could not have been achieved without it, through Center activities or SWEPS?

The Panel noted that HarvestPlus CP has several innovative features which set it apart from other undertakings in the CGIAR system. For example, the governance and matrix management structure in place facilitates the flow of information across crops, disciplines, cultures and institutions thus minimizing duplications, learning from best practices developed elsewhere within the program and enabling the sharing of new scientific findings derived from cross-disciplinary exchange of perspectives and methods. The Panel agrees that measures of cost effectiveness could be enhanced by closer coordination of work on several crops. for example relating the gene discoveries on the regulation of Fe and Zinc translocation from plant to seeds in wheat to those in rice and vice versa. HarvestPlus mission-oriented research focus on concurrently using conventional plant breeding and molecular biology on one hand and human nutrition and food science on the other to bring about nutrient-dense staple foods for the under privileged of the world is a path-breaking approach that is worthy of emulation by other researchers working on issues of pressing global importance. This mission oriented work, taking the best science has to offer in improving human nutrition, health and well being should serve as a model for others to follow.

The Panel views positively the extensive network of some sixty research and implementing organizations in over forty countries developed by HarvestPlus since its establishment. It is also noteworthy that this network is multidisciplinary in nature bringing together diverse disciplines ranging from human nutrition, food science, plant breeding, molecular biology, economics, farm extension, and communications.

4.5 Is there any evidence of synergies and/or new modes of operation of the Centers involved in the CP? Can these synergies be improved?

Synergies among the Centers involved are already built-in early on with the core management structure of HarvestPlus - the Program Management Team (PMT) being based at the two cooperating centers, namely IFPRI (Nutrition, Impact, Communications) and CIAT (Plant Breeding, Nutritional Genomics, Reaching End Users). The Program Director is based in IFPRI.

These strategies are further strengthened by the coordinating roles of the functional research leaders of the above disciplines across the six Phase 1 crop groups. One facet of the CP that would ensure the delivery of the final product is the 10-phase HarvestPlus Impact Pathway which includes phases of research, development and dissemination. While such strategies and new mode of operation are commendable, the Panel recommends that further steps be explored to ascertain that the final product be eventually acceptable to the target groups, namely the farmers that are going to be growing the crops and the consumers of such nutrients-rich staples. Without their early buy-in, there is always the prospect of such products not being acceptable to the intended users.

To what extent and when should NARS be involved in adaptive and participatory breeding activities of the promising varieties?

As discussed under who should be the end users of the CP, the Panel strongly recommends that the CP consider the NARS as the end users of its product (nutritionally enhanced crops) and thus include the NARS from the early stages of development to the implementation in pilot projects with farmers. This partnership is essential to enhance potential for sustainability of the effort and is most cost effective. An early and on-going engagement of HarvestPlus with stakeholders and target recipients of its research outputs is not only desirable but absolutely crucial. The Panel considers the partnership with the NARS as an essential component of implementation process; interaction with NARS should start early incorporating members of the national agricultural research community in the design of the new crops and training NARS staff so they can adequately support the implementation during the pilot phase and in the expansion phase. NARS should also be involved wherever possible in the evaluation of the nutritionally enhanced crops for agronomic properties and in gene/environment optimization processes.

4.6 Policies regarding intellectual property?

As the products of HarvestPlus are global public goods, all intellectual property arising from the CP must be freely available for use in developing countries. Participating institutions must agree and sign such Agreements prior to receiving any funds. The Panel takes note that a PAC committee has been formed to consider a reformulation of the HarvestPlus IPR strategy which would be based on many elements of the Generation Challenge Program structure.

HarvestPlus, and specifically the PAC, has spent considerable effort on clarifying the International Public Goods (IPG) nature of its program outputs. The original program proposal also addressed this point. While recognizing that the absence of a legal HarvestPlus entity would not allow direct Intellectual Property (IP)-related agreements between HarvestPlus and IPowners in the private and public sector, the original proposal defined a series of requirements on how Intellectual Property Rights (IPR)-protected program outputs owned by one or more collaborators would be handled, including publication and royalty-free and unrestricted access to the outputs through a licensing agreement. Subsequently, the PAC has revisited and updated the HarvestPlus IP-policy in almost every PAC meeting,

leading to the currently valid HarvestPlus IP-policy (see Governance and Management Handbook) that is largely in line with the original policy but contains a few adjustments.

Firstly, while IP-ownership remains with the collaborators that developed it, the royalty free, irrevocable, perpetual, worldwide, non-exclusive license (for non-commercial purposes only) allowing access is restricted in a first step to CIAT and IFPRI who then also obtain the right to sublicense to all other present and future HarvestPlus collaborators under the same conditions. Collaborators obtain the right to commercialize the Challenge Program IP in one or more of the "More Developed Countries and Territories". In this case, a royalty fee needs to be negotiated and is payable to HarvestPlus. The Panel did not assess the current HarvestPlus IP-policy in great detail. It seems, however, obvious that the IPG character of HarvestPlus outputs has been clear from the outset, albeit reduced to Regional Public Goods (RPG) targeted primarily at less developed countries in the case of commercialization. As recommended in the governance and management sections of this report, the Panel encourages HarvestPlus to update the Governance and Management Handbook (that contain the current IP policy) because recent PAC meeting minutes indicate that the discussion has moved further forward since the Handbook was last updated (in May 2005).

4.7 Are the rules and mechanisms for commissioned research transparent? Is there a well established, clearly defined and transparent internal control environment on implementing competitive grants?

The HarvestPlus original proposal differentiates between commissioned activities and competitive grants. Commissioned activities include those undertaken by collaborators in areas central to the core program pillars of nutrition, nutritional genomics, genomics, breeding, and policy analysis. Some central program services, such as sample analysis and plant nutritional pathway elucidation, will also be commissioned by the program to ensure consistency of results and obtain efficiencies of scale. Competitive grants are awarded in open competitions. An important aim of these competitive grants is to widen the pool of developing-country institutions and networks participating in the Challenge Program, thus building national and regional capacity in the target regions of the program. The PAC will determine a process for administering these open competitions, including peer review mechanisms, to ensure independence and transparency in the awarding of the grants within the Challenge Program. The original proposal sets a target that 25% of overall program funds to be awarded through competitive mechanisms. Currently, HarvestPlus commissions most of its overall programmatic funds. In fact if the estimation of proportion of open bid funding is applied to the overall program funds the competitive mechanisms accounts for only 5 % of the total budget.

There is clear dominance for commissioned activities in the HarvestPlus program and management strongly supports the present model. The arguments supporting commissioned research are that it is easier, leaner and more efficient to administer and that it helps in building real partnership. However on the down side the fact is that much of the commissioned research remains within the CGIAR centers or the initial universities/research centers that originated the HarvestPlus CP thus the opportunity to attract others is limited. Commissioned research at the very least needs careful monitoring and evaluation in place since it is difficult to have proper accountability in place when the contracted are also the owners of the program. It is crucial that the products to be delivered by the contractor be clearly established at the outset.

Competitive grants have been implemented more recently for the work on nutritional genomics and for specific methodological aspects to assess bioavailability of nutrients and interactions within the food matrix. The Panel considers that the best way to secure the highest quality scientific products needed by

the HarvestPlus CP to reach its key objective is to deliver nutritionally enhanced staple crops is to have a competitive award research program with clearly defined terms on both what is required and how it is delivered. The Panel suggests that the present target of 25 % of total funding should be respected and possibly expanded in areas where scientific breakthroughs that have potential bearing on the program objectives are foreseen.

4.8 In what ways has the CP contributed to capacity building of partners?

The Panel did not identify a specific capacity-building effort or program at the start of the HarvestPlus program. The Panel acknowledges that capacity-building is a long-term investment and requires substantial financial resources. So far there has been no specific funding allocation for capacity-building during HarvestPlus I but it was budgeted in HarvestPlus II. While it is understandable that a research of this kind may not have capacity building as its prime consideration at the outset, at this phase of its development, it is imperative that such a scheme be set in motion. It is evident from the documents provided that HarvestPlus has contributed to training efforts and educational programs conducted by others. The recent development and upgrading of methods and protocols used in the area of nutrition research, food analysis and nutrient content of plants have served to generate manuals and other materials that serve to disseminate knowledge, This is a clear contribution to training and capacity development workshops held in Brazil, China and Tanzania.

Training also took the form of post-doctoral fellowships on 'Breeding Objectives' at Cornell University or the University of Adelaide. While they may have been useful, such instances are 'ad hoc' at best. If the CP is to live up to its promise of being seen as a major research effort at tackling micronutrient deficiencies for the benefit of the poor in the developing countries, a major component of its future program should be capacity building.

While conventional breeding may be taken for granted in many places, it would be opportune to include this component in any training program besides food processing and human nutrition. Undoubtedly, high on the priority list would be training on nutritional genomics. Such training is preferably organized in situ in recipient countries with the active participation of NARS but it should not preclude training exchanges with training components in advanced laboratories in developed countries. Eventually, this CP program may spawn hands-on training on how to initiate, manage and coordinate a multidisciplinary program on research on issues of innovation of crops either for enhanced nutrition, agronomic superiority and possibly multiple uses of crops with particular traits deemed useful for human food production, animal feeds and other economic uses."

Annex B: GAT Summary of Regional Priorities, as discussed in the Regional Review Reports and the Regional Synthesis Reports ⁴

Asia Pacific

Priority Research Areas in South Asia

- Commodity-based
 - Rice, wheat, local staple cereals, pulses, livestock, horticulture and fisheries
- Overarching non-commodity-based
 - Climate change management,
 - Natural Resource Management (NRM),
 - Socio-economics, policy and value chain management,
 - Germplasm conservation and improvement,
 - Post-harvest management, agro-processing and value addition,
 - Quality improvement and safety, and
 - Rural non-farm employment and income generation.

Priority Research Areas in Southeast Asia

- Commodity-based
 - Rice, vegetables, fruits and aquaculture
- Cross-Sectoral Priorities
 - Enhanced productivity and sustainability for food and nutritional security and poverty alleviation
 - Increased resilience against climate change, extreme meteorological aberrations and market volatility
 - Value chain management and prevention of post-harvest losses
 - Genetic improvement, management of biotic and abiotic stresses
 - Enhanced accessibility of research outcomes on part of small and resource-poor farmers

Priority Research Areas in The Pacific

- Value-adding (inclusive) for niche markets (domestic and export) to be considered within a value chain approach, and alleviation of NCDs;
- Crop improvement to support value-adding and climate change and also for nutritional security;
- Climate change management through mitigation and adaptation (modeling lacking);
- Bio-security and trade facilitation – market access and farmer-market linkage; and
- Sustaining livelihoods in atolls.

Priority AR4D in Asia-Pacific as a Whole

- Productivity enhancement, increased input use efficiency and competitiveness, and informed diversification
- Integrated farm and natural resources (land, water, agrobiodiversity) management and enhanced

⁴ Sources: Singh, 2010; Beniwal, 2009; Richards and Chartier, 2009; Carriquiry, 2009; Mokwunye, 2009; El-Habbab and Smets, 2010.

sustainability

- Bridging wide yield gaps through revamping extension and services support, strengthening maintenance research, harnessing new technologies, enriching knowledge and communication domains and building human capital
- Resilience to climate change and natural disasters through developing adaptation and mitigation measures and restoring the balance of crop-tree-livestock-water-land cycles
- Resilience to volatile markets and abnormal economic shifts
- Value chain development – aligning farmers along the chain, prevention of post-harvest losses, value addition and quality enhancement,
- Socio-economic research for developing informed policies and decision-making and rendering AR4D accessible.
- Enhanced employment and income security through integrated on-farm – off-farm and nonfarm employment

Central Asia and the Caucasus

Based on the review of different reports, the following six major challenges for ARD have been identified for the CAC region (Beniwal, 2009: 2):

- Food security
- Improving the declining living standards and improving livelihoods
- Protecting the environment
- Achieving structural reforms
- Meeting the special challenges (both existing and future)
- Strengthening national agricultural research systems

These challenges have been further disaggregated in the following 18 “key issues”:

- Key Issue 1: Provide effective financing of agriculture and farms to support newly-emerged small-scale farmers and dekhon (rural household farming/kitchen farming/mini-farming) in the region
- Key Issue 2: Enhance the sustainable productivity of agriculture in the irrigated or rainfed/lessfavored or “lagging” areas while protecting the natural resource-base
- Key Issue 3: Need to explore the full potential of livestock sector in the region
- Key Issue 4: Need to pay a much greater and special attention to horticulture sub-sector
- Key Issue 5: Need to emphasize on research on fisheries and aquatic production systems
- Key Issue 6: Need to pay attention to trans-boundary animal and plant diseases and pests
- Key Issue 7: Need to develop and manufacture machinery for use by small-scale farmers
- Key Issue 8: Study and analyze the declining living standards and livelihoods in rural areas and develop opportunities for household income generation
- Key Issue 9: Improving the livelihoods of small-scale subsistence farmers in the mountains of CAC region
- Key Issue 10: Organize and promoting the role of rural women in agriculture, and agricultural research and development
- Key Issue 11. Enhancing efforts on protecting the precious land and water resources
- Key Issue 12: Protect the much useful forests from degradation and embark upon afforestation and agro-forestry programs/campaigns
- Key Issue 13: Enhance efforts on protecting precious vast natural biodiversity present in the Region
- Key Issue 14: Developing legal frameworks for land tenure, access and property rights
- Key Issue 15: Improve the structures for irrigation to make irrigated agriculture to improve efficiency of the irrigated agriculture
- Key Issue 16: Aligning agriculture research and development to meet the challenges of global warming, i.e. adaptation to and mitigation of climate change

- Key Issue 17: Need to address the issues that relate to Aral Sea problem considering its great importance and serious implications in environment and agriculture
- Key Issue 18: Need to address the issue of desertification.

Europe

In addition to the overarching need to focus research on poverty reduction, the following six issues were identified as priorities (Richards and Chartier, 2009b: 5):

- Climate change – forecasting, alleviating, coping, mitigating
- Growing pressure on environment and natural resources due to growing population,
- Energy security – food or energy dilemma, Biofuels, energy efficiency, alternative sources, low input systems, more energy efficient agricultural systems, relevance to the poor
- Increasing demand for food and change in consumption and dietary patterns
- Plant & animal diseases; forecasting and coping with pandemics
- Globalisation – ensuring the poor are not disadvantaged

“Perhaps the most important message from the consultation in Europe is the urgent need to start initiatives on improving agricultural research for poverty reduction in eastern Europe. It appears that the incidence and prevalence of relative and absolute poverty in Europe are on the increase – particularly in rural locations and city slums.” (Richards and Chartier, 2009b: 7).

Latin America and the Caribbean

The regional review (Carriquiry, 2009) identified 5 "key factors" as regional priorities:

- Increasing production and productivity,
- Diversifying and differentiating agricultural products and services,
- Increasing quality and food safety,
- Facing the challenges of climate change,
- Conservation and sustainable management of natural resources (extension of the “border within the border”),
- Developing the agro-energy issue and g) promoting institutional innovations.

On the basis of these “key issues”, the e-consultation and the F2F meeting has put forward the following priority areas for the region.⁵

Increases in production and productivity (focus on):

- Renewed efforts on traditional crops-wheat, maize, rice, beans, potatoes, cassava, among others – having a high participation in the global food supply, as well as progressing on species underserved, particularly in tropical areas and sectors of small scale and family agriculture, and

⁵ The priorities listed are extracted from Table 1 in Carriquiry 2009, the editing has not modified the verbal presentations of the priority topics, but for clarity of presentation the columns referring to “Bottlenecks to resolve...” and “Institutional mechanisms and partnerships....” are excluded.

- Better utilization of existing productive land within the current agricultural frontier, so as to not only contribute to increased production, but also contribute to the protection of fragile ecosystems - particularly tropical forests

Addressing the challenges of climate change (need for adaptive responses to):

- Reduce vulnerability to short-term climatic events (year to year) through:
 - genetic improvements for enhanced crop adaptation to highly variable conditions,
 - development of early warning and early response systems,
 - generation of studies and information to improve risk management, and
- Medium-term effects through the development of more information about which will be the changes in the agro-ecological and productive scenarios (migration of pests and crops, prospective studies of changes in forms of production) as the basis for development of sectorial policies was identified.

Diversification and differentiation of agricultural products and services (In this area research should focus on):

- The development of technologies and innovations aimed at exploiting market "niches",
- The recovery of species and varieties, now little used or used only by small farmers in local markets,
- The development of quality labels for small-scale agriculture as a source to support income generation and its better social sustainability.

Food Safety & Quality (Research in food security should be aim at):

- Ensuring sustained increases in staple food production, particularly those who depend on low-income sectors of the population,
- Reduce losses due to the incidence of pests and post harvest handling
- Improving access to food for rural households through diversification of their sources of income for better utilization of productive resources at their disposal.
- As for food quality, (efforts) should be targeted a higher value-added food and ensuring their health and safety through the development of practices and monitoring and control standards allowing to establish sanitary equivalence between the domestic and export markets.

Development of agro-energy (To ensure the benefits of agro-energy to both the region and the global environment, research should be focused on):

- Identification and technological development of new sources of raw materials that are not competitive with food production,
- Progress in developing technologies for second and third generation and the use of lignocellulosic materials, and
- Integrated production models which can incorporate a small-scale agriculture to agro-energy production, and integrate these new schemes in local development strategies.

Conservation and sustainable management of natural resources (Research focused on):

- The development of technologies to optimize the use of water and soil resources, including both specific issues such as the development of good practices,
- Expanding the use of environmentally friendly practices such as the integrated management of pests and

nutrients,

- Progressing in the sustainable use and conservation of biodiversity, including everything related to in-situ conservation, complemented by ex-situ, genetic improvement and strengthening of seed systems, and
- Providing a scientific basis for production with an agro-ecological approach

Promotion of institutional innovations (Generating knowledge and promoting institutional innovation processes to):

- Facilitate the integration of STI policies, agriculture, socio-economic and other, and concentrate on the promotion of innovation (rather than generation and dissemination),
- Ensure the sustainable development capacity in new areas of knowledge and technologies,
- Considering the inclusion of family agriculture or small scale innovation systems,
- Facilitate the development and operation of national and international networks, and other collective arrangements for R & D aimed at innovation, and
- Provide for the strengthening of local, national and regional technological innovation, and their new interaction with the various existing international schemes, in general, and the CGIAR, in particular.

Sub-Saharan Africa

ARD priority themes for Africa and the priority areas for engagement with international partners include (priority areas for engagement are bulleted):

Risk and vulnerability:

African ARD should enable smallholder producers to become better prepared to respond to effects of climate change and other global crises (e.g. financial, trade, food, diseases and energy)

- Strengthening of African human and institutional capacities to assess risks and to develop mitigation and adaptation measures (early warning, response and recovery)
- Sharing relevant information, technology, lessons and experiences
- Realignment of investments to increase funding for interventions aimed at mitigating risk and vulnerability.

Institutional and Policy dialogue:

Testing and up scaling institutional and policy arrangements that promote agricultural innovation across entire value chains.

- Strengthening of human and institutional capacities for policy analysis, evidence based advocacy and innovation systems approaches
- Fair trade policies, e.g. removal of barriers to Africa's agricultural products
- Alignment of investments in rural development to agricultural priorities, e.g. transportation and water infrastructure

Information, knowledge and innovation

Support to generation of knowledge through science and technology; building on indigenous knowledge and use of success stories for scaling up good practices.

- Strengthening Africa's capacity for generation, dissemination and use of agricultural knowledge and knowledge management tools e.g. ICT and knowledge banks
- Supporting the exchange of innovations between Africa and the rest of the world
- Strengthening intellectual property rights regimes for ARD

Coordination, partnership and networking

Strengthening institutional frameworks for harmonizing ARD priorities and their implementation at national, sub regional, continental and global levels

- Aligning interventions and support to existing frameworks notably CAADP, FAAP and national compacts
- Supporting platforms for inter-regional cooperation (south-south and north-south)

Land and water management

Priority issues concerning management of common property resources, policies to support investment in sustainable land and water use. Policies to protect tenure rights of smallholders in the face of "land grabs"

- Strengthening the human and institutional capacities to address land and water management issues (soil fertility management, land degradation, forest management, land tenure and water rights). This includes sharing relevant technologies.
- Formulation and enforcement of international conventions and protocols on land and water management

Monitoring and Impact Assessment

There is need for easy-to-understand methodologies for measuring success and funding arrangements that allow impact assessment and lesson learning.

- Strengthening capacity for monitoring, evaluation and impact assessment for using the resulting information to enhance impact
- Developing and applying appropriate methodologies for assessing impact areas

Food security

Access to technologies that increase productivity, increase in market access and making it possible for producers to cope with uncertain weather conditions given the increasing rural and urban populations in Africa

- Strengthening capacity for development and up-scaling of technologies, policies, markets for increasing food productivity, reducing post harvest losses and increasing food quality (nutrition).
- Increasing investment in infrastructure and support for policy regimes that promote domestic and regional trade in food

West Asia and North Africa

Basic priority themes and issues were identified by the regional review (August 2009), and they include.

Food security

- Need for research on the comparative and competitive advantage of regional products
- Need for effective financing of agriculture to support small-scale farmers in the region
- Enhance the sustainable productivity of agriculture in irrigated and rain fed areas, which “lagging behind” in terms of productivity, while protecting the natural resource-base
- Need to explore the full potential of the livestock sector in the region
- Need to emphasize research on fisheries and aquatic production systems
- Need to pay attention to trans boundary animal and plant diseases and pests

Improvement of the livelihoods of farmers (poverty reduction)

- Analyze the declining living standards in rural areas and develop opportunities for household income generation
- Organize and promoting the role of rural women in agriculture, and agricultural research for development

Protection of the Environment

- Enhancing efforts on protecting land and water resources
- Protecting forests and rangeland from degradation
- Enhance efforts on protecting the natural biodiversity in the region

Meeting the special challenges of climate change

- Align agriculture research and development to meet the challenges of global warming.
- Need to address the issue of desertification

Technology, information, knowledge and innovations

- Enhance investment in and strengthen agricultural research, innovation, extension and education systems, related institutions and research processes
- Revitalize, strengthen and reorient agricultural extension system
- Improve quality of agricultural education and employability of agricultural graduates and increase availability of appropriately trained human resources at different levels

Market and marketing

- Effectively link small and marginal farmers with markets, including the fast emerging large (multi-national) retailers and super markets
- Benefit small farmers and protect consumer from food price rise and fluctuation

Energy

- Develop bio-fuels as a complement to fossil fuel, but not at the cost of food security
- Enhance energy security compatible with economics and ecology.

The e-consultation confirmed the key researchable issues as summarized above and, at the same time, however, new issues were also identified. Among them:

- Poor linkages between research, extension and farming communities
- Improving and adopting innovative ways of knowledge sharing
- Implications of water scarcity and its impact on regional food security
- Adopting a strategic approach towards agricultural research
- Better integrating policy and institutional issues in research programs (El-Habbab and Smets, 2010: 8)

Annex C. Illustrative Partnership Performance Indicators

The information below was extracted from Annex 1, "Key Performance Indicators/Log Frame Matrix", of the *Implementation Completion Report on a Loan in the Amount of US \$60.0 Million Equivalent to the Federative Republic of Brazil for an Agricultural Technology Development Project*.⁶ Although the details are specific to the EMBRAPA program, they are included here to give the reader examples of comprehensive performance indicators for measuring partnerships.

Table 1a. Key Performance Indicators - Project Development Objectives

1. % financing for Competitive Grants System coming from beneficiaries.
2. Number of public/private partnership contracts signed.
3. State Research contributions to competitive grants in funded projects (R\$m.).
4. % of EMBRAPA's non-budget revenues through sale of products, processes and services, including collaborations and grants, allocated in the CGS.
5. % of resources from Competitive Grants System allocated to institutions other than EMBRAPA.
6. Increase in the % of projects led by institutions other than EMBRAPA through competitive grants.
7. Percentage of subprojects coordinated by non-EMBRAPA institutions.
8. Increase in the % of projects implemented by two or more institutions through competitive grants.
9. No. of universities collaborating with EMBRAPA.
10. No. public agencies participating as executors or collaborators.
11. No. of cooperatives participating in R&D activities.
12. No. of farmers' organizations participating in R&D activities.
13. No. of NGOs participating in R&D activities.
14. No. private organizations participating as executors or collaborators in R&D.
15. No. technical assistance and extension entities participating in project R&D.
16. No. CGIAR and other foreign institutions participating in project R&D.
17. No. scientific and extension publications originating from supported grants.
18. Books generated.
19. Academic theses approved.
20. Training courses for target public.
21. No. patents registered or in process, resulting from project-supported R&D.
22. Annual operating budgets to research on small farm development programs (R\$m) by EMBRAPA for SNPA over its 1996 allocations for small farm development.
23. Annual operating budgets to research on natural resource management (R\$m) by EMBRAPA for SNPA over its 1996 allocations for natural resources program.
24. Annual operating budgets to research on advanced technology development (R\$m) by EMBRAPA for SNPA over its 1996 allocations for biotechnology program.

⁶ The World Bank. 2006. "Annex 1: Key Performance Indicators/Log Frame Matrix" in *Implementation Completion Report on a Loan in the Amount of US \$60.0 Million Equivalent to the Federative Republic of Brazil for an Agricultural Technology Development Project*. Report No. 35815. ESSD Brazil Country Management Unit, Latin America and the Caribbean Region. Washington, DC: The World Bank.

25. % of EMBRAPA's national operational budget allocated to competitive grants
26. EMBRAPA's staff support to state research systems (R\$m).

Table 1b. Performance Indicators - Training and Equipment

1. No. EMBRAPA staff trained
 - a. Foreign PhD
 - b. Local PhD
 - c. Post Doctorate
 - d. Local M.S.
2. No. of DUs supported with infrastructure/equipment
3. No. DU and SRC staff given long-term training in IPR
4. No. scientists placed on long-term assignments in advanced foreign research institutions
5. No. SRC staff trained
 - a. Foreign PhD
 - b. Local PhD
 - c. Post Doctorate
 - d. Local M.S.
6. No. SRCs supported with infrastructure and equipment

NOTE:

DU: EMBRAPA's decentralized research units (state level)

SRC: State Research Centers

Annex D: Terms of Reference (TORs) for the Global Author Team

NOTE: *The Terms of Reference included below represent what was originally discussed by GFAR and the Global Author Team (GAT) late 2009; they do not include revisions, discussions, and agreements that transpired during the writing process. Important changes not mentioned below include the presentation of a **draft** report at the conference, and the finalization of the report following the conference, to ensure inclusion of key issues and the “Road Map” that emerged from GCARD 2010.*



The Global Conference on Agricultural Research for Development:

Draft Terms of Reference for a global team of Consultants to review, analyse and synthesize changes needed in the global system for agricultural research for development

1. Background & Context

The world faces unprecedented development challenges, rocked by recent crises in both food supply and global recession, while needing to address significant long term challenges such as climate change. Millennium Development Goals of eradicating extreme hunger and poverty, of environmental sustainability, the advancement of women and of meeting basic education, child nutrition and health needs are all strongly linked with rural development. Yet developing countries are struggling to meet all these goals. Projections of food demand, changing food consumption patterns and the increased conversion of food into bio-energy mean that production must be increased in sustainable ways and without continuing to increase the consumption of natural resources such as land and water.

The global aid architecture is changing rapidly, with more concerted development funding following the food price crisis and, through the Paris and Accra Declarations, international partnership developing between funders and beneficiaries, with mutual accountability for delivery against agreed development targets. In line with such changes and to meet the many new challenges, change is also needed in the global architecture of AR4D and the institutions involved (agriculture here includes crops, fish, livestock and forestry).

Effective agricultural research for development systems linking international institutions with national needs and capabilities and with projected future concerns, are essential to meeting global development commitments. So, also are systems of innovation (and its scale-out) that link science and society through public, private and civil partners working together in more coherent ways. The world's AR4D systems are not only under resourced, they are also disconnected from processes supporting wider development, face numerous bottlenecks and barriers between, and sometimes inside, their constituent institutions and crucially may often lack substantial connection with, input by and accountability to their intended beneficiaries. Significant change is required in the institutions and mechanisms involved in both generating new knowledge and the empowerment of users of this knowledge (mostly rural communities) so they can effectively put it into use to improve their own circumstances. The required changes are recognized in the current processes of change in the CGIAR, which is itself a major catalyst of the need for reform in the global agricultural research for development system, to ensure an effective and integrated system can deliver the development impacts required.

2. List of Important Acronyms

Agricultural research for development (AR4D)

Consultative Group on International Agricultural Research (CGIAR)

Global Conferences on Agricultural Research for Development (GCARD)

Global Forum on Agricultural Research (GFAR)

International Assessment of Agricultural Knowledge, Science & Technology for Development (IAASTD)

International Fund for Agricultural Development (IFAD)

International Federation of Agricultural Producers (IFAP)

Strategic Results Framework (SRF)

Food and Agriculture Organization of the United Nations (FAO)

World Development Report (WDR)

Regional Research Fora:

Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA)

Asia-Pacific Association of Agricultural Research Institutions (APAARI)

Central Asia and the Caucasus Agricultural Research Institutes (CACAARI)

European Forum on Agricultural Research for Development (EFARD)

Forum for Agricultural Research in Africa (FARA)

Forum for the Americas on Agricultural Research and Technology Development (FORAGRO)

3. Overall Purpose of the GCARD

The Global Forum on Agricultural Research (GFAR) is organizing a series of GCARDs, working through its constituent agencies and networks, which include the CGIAR, the FAO and IFAD, the International Federation of Agricultural Producers (IFAP), the Regional Research Fora (FARA, EFARD, AARINENA, APAARI, CACAARI and FORAGRO) and representatives from civil society, the private sector and donor agencies.

Over the period 2009-2015, a rolling process of analysis, e-consultations and face-to-face discussions will aim to develop and refine a new global system for agricultural research for development. A series of cycles of learning and feedback every two years will discuss and seek to continuously improve agricultural research resourcing, impacts, delivery and accountability to its intended beneficiaries, the poor of this world. These Global Conferences replace both the GFAR Triennial Conference and the Annual General Meeting of the CGIAR.

The processes of consultation leading to each GCARD Conference will bring together diverse partners to develop agendas, capabilities and ways of working in agricultural research for development, that address the challenges of the future, are centred on the needs of the resource

poor, in particular for poor farmers and agricultural producers and demonstrate robust and equitable international partnerships able to attract investment and deliver development impact.

The Global Conference aims to ensure that:

- Research is focusing on the right approaches and questions to meet the needs of resource-poor farmers **and** the needs of poor consumers for sufficient, affordable, healthy food, to increase global food supplies, and sustainably harness agriculture as an engine of economic growth.
- Research is embedded into development processes, with outputs accessible and relevant to the poor.
- Scientific knowledge and advances impact development thinking and practices.
- Funding systems are aligned between research and development funding, to ensure effective investment in the new forms of institutions and partnerships required for delivery of development impacts drawing from the generation and use of knowledge.
- The international research system is effectively integrated with national partners (public, private and civil) and responds to national and sub-regional (or trans-national) demands to help ensure development impact.

The GCARD seeks to lay the ground for change in the basic architecture of agricultural research for development. It will provide opportunity for all those concerned about the future of agriculture and its role in development to contribute towards building and investing in more coherent and effective research systems that can be valued for their development impact.

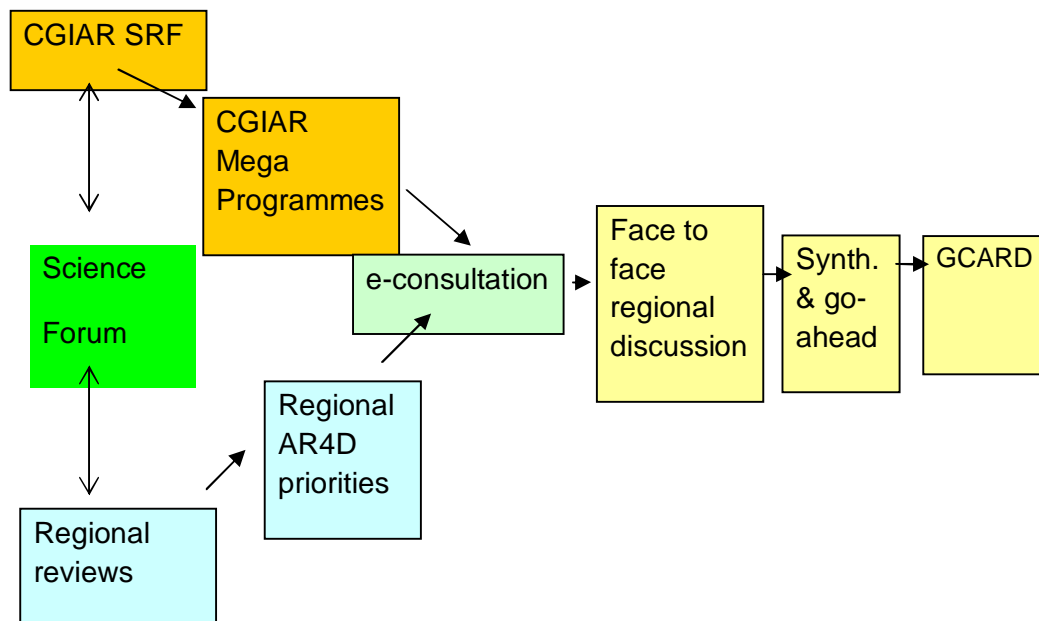
It also provides the key mechanism for consultation and ground-truthing of the new strategy and results framework-setting process of the CGIAR (and its component “mega-programmes”) and ensuring these reflect the needs and aspirations of partners in developing countries. Development of mutual accountability in such processes is essential to realizing the value of the international system in support of national development needs.

The process is being organized through a multi-sectoral Task Force, chaired by Dr. Monty Jones (FARA Executive Secretary), reporting to the GFAR Steering Committee, and tasked with ensuring a successful and dynamic that lays out a new demand driven focus for agricultural research that is directly targeted towards achieving key development objectives and identifies ways in which institutional investment and reform are required for research to be more effective in development. This to include areas of capacity need, institutional behaviour and modes of operation that pay particular attention to the needs of small farmers and of development processes identified from the countries and societies themselves. This requires processes to be open and inclusive of all those who care about the future of agriculture and the role of agricultural research in development.

The GCARD effort for 2009-2010 consists of several different elements, connected by open and inclusive consultation. These include:

1. Regional review through synthesis and analysis of existing national and regional documents to produce a high-level regional development context and refreshed, high-level set of regional agricultural research priorities.
2. Electronic consultations and face-to-face dialogue to provide perspective on the priorities and on how improvements to research systems and innovation pathways may be able to create more, and faster, development impact.
3. Development of thinking within the international research community around the specific role and purpose of international research (consultation around the CGIAR SRF and large-scale programmes) and discussion of the role of advanced science in international development (Science Forum, June 2009). (The Science Forum background papers are available, but the full proceedings will not become available until February 2010).
4. The conference to be held from 28 March to 1 April, 2010 to align disparate stakeholders in agricultural research around a common agenda.

The GCARD process



4. Purpose of the GCARD Regional Reviews and Consultations

The process of consultation towards the March 2010 Conference will begin with a synthesis of existing documents, including development reports, regional research priorities, national and regional agricultural frameworks, etc. with the purpose of producing:

- A high-level regional development context and refreshed, high-level set of regional agricultural research priorities
- Evaluation of current regional implementation mechanisms (predominance of public, private and civil mechanisms for sharing knowledge and creating pathways of innovation)
- Identification of areas of specific need for the poorest in each region
- A set of key issues requiring wide public consultation to improve the value of agricultural research in achieving development goals

This synthesis will be conducted on a region-by-region basis⁷, and is intended as a broad-based analysis for each developing region, identifying and framing key issues for subsequent global and regional e-consultation to improve research-development linkages. Consultants with expert knowledge of each region have been recruited for each region and have been producing their reports.

A parallel and related effort, being driven by the Alliance of CGIAR Centers, is focusing on conducting a higher-order synthesis and review of global development reports and global priorities. This team is conducting an initial analysis of global policy issues and analyses, such as the 2008 WDR and the 2008 IAASTD to find areas where the CGIAR's efforts are likely to bring best rewards in large-scale development impacts and so developing a draft Strategic Results Framework for the CGIAR.

The Science Forum, held in June, complemented these processes by providing a perspective on where advanced science might be able to contribute to development in meeting future challenges. Output from the Science Forum will be made available through these processes as background materials and draft papers

These frameworks will themselves be laid open to public consultation and feedback through the GCARD process. The outcome of this work will be a key input toward the development of a draft overarching agricultural research framework.

⁷ *Developing regions to be addressed are: Africa; Near East; Central Asia & Caucasus; Asia & Pacific; Latin America & Caribbean; Europe*

Specific Deliverables from each Regional Review

Final report (see Section 6) that articulates the following:

- High-level regional development context and refreshed, high-level set of regional agricultural research priorities
- Current AR4D implementation mechanisms
- Fit between recommendations and implementation
- Areas of specific need for the poorest in each region
- Set an initial frame for further exploration of key issues requiring wide public consultation to improve the value of agricultural research in achieving development goals

5. Next steps resulting from the study: electronic consultations and face-to-face dialogue

Upon completion of the Regional Reviews, an initial round of facilitated, open e-consultations, with open questions derived from the findings of the regional studies will be conducted to provide deeper understanding of the needs, perspectives, and expectations of different sectors on the issues raised. This will particularly focus on which innovation pathways are likely to achieve these desired outcomes, what are the barriers and constraints to their currently doing so and what changes in capacities and behaviour are required to enable these to succeed in practice. These processes together are intended to provide answers to the questions:

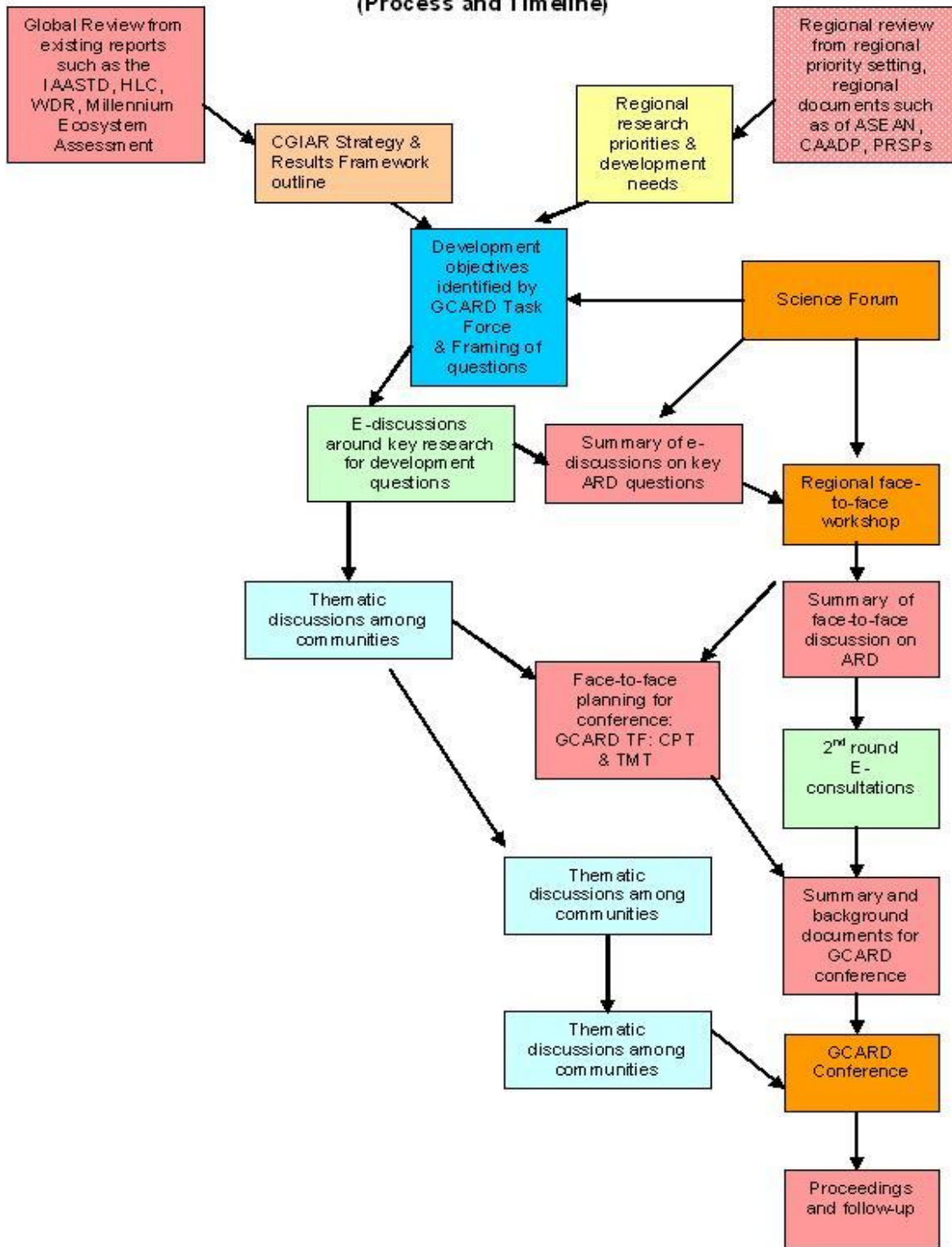
- 1. What are the needs and priorities for agricultural research in delivering defined development impacts?**
- 2. What mechanisms and partnerships are required in innovation pathways turning research into development impacts at scale?**
- 3. What are the key blockages, barriers and bottlenecks that prevent research from benefiting the poor?**
- 4. How best should these be resolved and what enabling investments, policies, behaviours and capacities are most needed?**

The synthesis of these e-consultations will be brought together via face-to-face meetings in each region, involving the consultants, allowing integrated debate of the specific issues arising. The process of consultation establishing the CGIAR Strategic Results Framework (SRF) is directly integrated with the GCARD process. The GCARD e-consultation and face-to-face dialogues will thus also include specific consideration of the issues raised in the establishment of the SRF and 'mega-programmes' of the CGIAR.

An additional round of e-consultations would allow further elaboration of specific themes and their inter-regional significance before the GCARD Conference in Montpellier, France (28 March to 1 April, 2010).

The overall process is summarized in the flowchart below.

GCARD Consultation and Conference (Process and Timeline)



6. Composition and role of the global author team (GAT)

A global author team (GAT) is required, composed of 4 consultants of international standing, to review and synthesize in writing the outputs from the regional reviews, E-consultations and face-to-face meetings, to draw lessons across the regions and extract key elements with inter-regional/global relevance.

They will report to and be guided by the GCARD Task Force (and in turn the GFAR Steering Committee) and have a prime role in synthesizing and outlining expectations and preparing a concise summary of requirements of the new requirements of *agricultural research for development systems around the world*, to deliver more significant development impact in defined key areas. This document will be the key document for public discussion in Montpellier.

The GAT will also need to liaise closely with the CGIAR- Alliance commissioned SRF team currently developing the outline SRF (led by Joachim Von Braun) and mega-programmes for the CGIAR, which is itself one constituent of the global AR4D system.

7. Timeline, Process and expected deliverables from the Global Core Group

Deliverable 7.1 Consolidated global-perspective summary report.

The regional e-consultations, face-to-face meetings and the dialogues they spark will examine the issues raised from the regional review from a wide variety of perspectives and situations, including those of civil society and specific interest groups and put forward constructive arguments for areas which require attention to improve these capabilities, outcomes and inter-linkages. These reports are compiled by regional authors commissioned by each regional forum.

The global consultants will draw together these outcomes into a global summary report. This will require cross-analysis of outcomes from the regional processes and the use and incorporation of significant previous global and inter-regional/regional analyses, such as the World Development Report, IAASTD, FAO Conferences and CGIAR SRF proposal, as may be required. For this they will be provided with a support research assistant, funded additionally by the GFAR Secretariat and sub-contracted to the team.

The GAT will also need to ensure that the report includes effective consideration of the SRF and outline 'mega-programmes' under development in the CGIAR. These latter form one component of the global action plan to be developed and are intended to focus collective actions on key areas of development need in which the CGIAR has particular competence. The extent to which these resonate with analyses derived from the regions should be considered by the GAT as they incorporate these proposed areas.

The global team will summarize from the global perspective:

- | |
|--|
| <ul style="list-style-type: none">I. Existing Needs and recommendations<ul style="list-style-type: none">a) Review and synthesize the range of global development priorities in which agriculture and food play a roleb) Review and synthesize existing global research priorities in agriculture and food |
|--|

- c) Draw on summaries of GCARD regional agricultural development/agricultural research reviews and outcomes from the preliminary analysis by the team developing the CGIAR SRF, to identify issues of global concern.
- d) Cross-analyse a) and b) with c), to identify coherence and gaps in current and projected research priorities against development aspirations over the next fifteen years
- e) Identify new needs that are recognized but not yet addressed in these strategies and insert in context as appropriate

II. Current implementation mechanisms

- a) Extracting from regional studies, give a broad global overview indicating current institutional and infrastructural arrangements and trends in arrangements that support rural (and urban agricultural) development
- b) Give a broad overview of the main research uptake and innovation pathways of global relevance.
- c) Examine the relationship between a) and b) to identify their extent of coherence and key gaps

III. Fit between recommendations and implementation

- a) Outline gaps and scale issues creating key challenges for the current institutional capacities and mechanisms in research and extension/innovation systems in delivering against known development aspirations
- b) From these preliminary analyses, frame key questions to be addressed through e-consultation that address the development challenges involved.

IV. Ensuring the needs of the poor are met:

Identify specific issues relating to the role of agriculture for the poorest rural sectors and the extent global priorities address these.

- a) Review and synthesize the extent to which the needs of the poorest are addressed globally,
- b) Identify key areas where agricultural research is being proposed to explicitly improve the livelihoods of these people.
- c) What are seen as the main development barriers constraining the escape from poverty of these people and what forms of new knowledge, capacities and skills could best help overcome these?

V. From the above, identify key issues in creating more effective agricultural research for development and formulate suitable questions for public consultation through prior e-consultation and in the Montpellier Conference, around these.

The final report will be required by the 28 February 2010 for prior circulation to the GFAR Steering Committee for their endorsement of its main conclusions and the preparation of necessary printed materials and structuring of discussion sessions.

An outline framework from the GAT on how they see the key issues and how these are intended to be shaped over the next few months to come together as an action plan and Declaration for discussion in Montpellier will be presented to the GFAR Steering Committee, November 14, for their comment and endorsement.

Deliverable 7.2: Issues of global/inter-regional significance for further e-consultation

A full draft report from each region is required from the *regional* consultants by the GFAR Steering Committee meeting 13-15 November. The global core group will work with the regional consultants as these reports are compiled, to extract and formulate priority issues of inter-regional and/or global concern that they feel require further public consultation and supporting analysis as may be required, to improve the way in which research and extension systems address the many-fold challenges facing resource-poor farmers, while also meeting the food security and food access needs of the poor.

The GAT will also draw from the CGIAR SRF as this becomes developed, as the plan by which international research organizations aim to collectively address priority development agendas through their research and as part of the actions needed globally in support of national agricultural research for development systems.

The issues and key themes proposed by the GAT to be further explored through the e-consultation will be discussed with the regional consultants and discussed in outline with the GFAR Steering Committee meeting 13-15 November for their consideration and approval of the general direction and process to be followed.

Deliverable 7.3 Second E-consultation

The regional e-consultations have produced a dynamic engagement with many stakeholders and the global process should build on from these, further enhancing the contributions from diverse stakeholders.

From the questions identified in 7.1, the global authors will develop the frame for a second round of e-consultation addressing issues which are of inter-regional common significance and work through consultant Simone Staiger and the consultation facilitators active in each regional research forum for the implementation of this consultation through addressing common issues across different regions. This second round will also need to help shape the future integrated programmes of the CGIAR towards clear development targets and explore how the role of the CGIAR might best add value in the areas concerned.

Feedback from this second round will also be drawn on by the consultants for their final report.

To maintain momentum from other consultations, this second round is expected to take place in December 2009.

Deliverable 7.4 Advisory inputs to GFAR's GCARD-associated actions

A number of associated activities are underway alongside the consultation and review processes and the GAT are expected to maintain links with these actions, via the GFAR Secretariat in the first instance, to provide advisory input and to draw learning from their outcomes to strengthen the report and action plan. Subjects receiving specific additional attention and their intended lead implementing agencies (all of which are expected to be completed by end of February) are:

- The role of women in research and research for women farmers
- The potential of new funding mechanisms for strengthening the role of farmers and other partners in agricultural research development and implementation
- A desk study of the scale and returns from agricultural research investments around the world
- The changing landscape – the role of the fast growing economies in learning from the implications of economic development for agricultural research and the role of national capacities as providers of S-S support in agricultural research and advisory systems
- The scale of need in new advisory systems and opportunities for strengthening rural advisory services
- Greater engagement of civil society organizations in shaping demand for agricultural research around the world
- Identifying the training and career needs of young professionals in agricultural research for development

Deliverable 7.5 Final report to GCARD, Montpellier, March, 2009.

By aggregating all these results, including those from the second round of e-consultation, the GAT will produce a final synthetic report to be discussed at the GCARD, Montpellier. This will need to be made available to the GCARD Task Force and GFAR Steering Committee for their prior consideration by 28 February 2010.

This report will be discussed in the conference as an action plan, a template for investment and development of new agricultural research for development systems around the world, focused on key investment needs and associated reform through involvement of all stakeholders, demand driven processes and principles of equitable partnership and mutual accountability. These reformed systems should aim to increase the value and speed up the impacts of agricultural research in development, through collective action against high priority development needs. It will be the basic core document for the one-day Conference session on "Current priority development challenges and the potential role of research in delivering desired impacts".

The plan's focus should be on the needs of national AR4D systems (including public, private and civil actors) and specific issues for the poor. It will recognize the complex pathways between producers and researchers. It should also include consideration of the enabling environment required for collective research and innovation actions, in more integrated systems, to have greater impact against key development objectives, balancing increased productivity with sustainability. It will include the

proposed scope of the CGIAR SRF and 'mega-programmes' as components within the bigger agricultural research for development system globally.

The report should be policy-informing, not policy prescriptive and not bound to particular production systems or technologies. It should present options and their implications for how to better meet development objectives through the use of research and the application of knowledge.

Specific key elements are:

- New forms and scales of research and other investment required along innovation chains for diverse actors to work better together towards rapid impact against development targets
- Research systems and policies that take better account of farmer realities and the complex needs of agricultural development going forwards
- The role and implications of new technologies in terms of their accessibility, relevance and value addition to the poor
- The requirements and implications of system sustainability and risk management for the poor and underprivileged sectors

Deliverable 7.6 Draft Declaration from Montpellier

Also expected for consideration in Montpellier will be a brief declaration of required norms and behaviours for agricultural research for development systems around the world, based on mutual accountabilities and responsibilities with other partners, proactive partnership development in research programmes so that research agencies are responsible for ensuring effective uptake pathways are in place and clear responsibilities among research funders to ensure that work supported towards development objectives is matched to associated inputs required for its development impact. This Declaration should take the level and content of the Paris Declaration/Accra Agenda as its guide.

8. Specific Skills required

Each member of the GAT is requested to have the following skills:

- Experience and expertise in rural and agricultural development issues and ability to take a bigger picture view of global issues. Each team member must be a "strategic thinker understanding the changing landscape of agricultural research for development".
- Familiarity with research and innovation systems and their management.
- Ability to write well in English.
- Ability to deliver outputs on time.
- Capacity to synthesize a large volume of information in a short text.
- Familiarity with the agricultural production systems, needs and innovation systems at global scale.
- Ability to take a bigger picture perspective on issues that cut across institutions and disciplines and openness to a range of views.
- Ability to work effectively as part of a larger team, with a range of regional consultants and under time pressure.